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EVALUATION OF SHREDDING FACILITIES ROCK CUT ROAD PLANT NUMBER 1. ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY, ONONDAGA COUNTY, NEW YORK

Onondaga County Solid Waste Disposal Authority

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This report details the evaluation of an Eidal Model SW-1150 solid waste shredder. It includes a description of the process; the facility throughput; power requirements; wear rates and predicted life of equipment; operating problems including jams, fires, and electrical problems; discharge particle size; maintenance; and cost data. Recommendations are also listed to improve the performance of this type of operation.

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EVALUATION OF SHREDDING FACILITIES ROCK CUT ROAD PLANT NO. 1

ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

ONONDAGA COUNTY, NEW YORK

This final report (SW-86d) describes work performed
for the Federal solid waste management programs under grant No. G06-EC-00318
to ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
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U.S. ENVIRONMENTAL PROTECTION AGENCY

1975

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PREFACE

This report contains the results of an evaluation study of Unit No. 1 of the solid waste shredding facilities at Rock Cut Road in Onondaga County. The project was conducted by Konski Engineers, P. C. under contract with the Onondaga County Solid Waste Disposal Authority for the U. S. Environmental Protection Agency. The collection of data commenced on January 2, 1974.

Acknowledgement for the very valuable assistance in the conduct of this study is expressed to the staff of the Onondaga County Solid Waste Disposal Authority and in particular to Mr. Charles J. McPhail, Operations Manager; Mr. William Rhyner, Superintendent; Mr. Anthony Colella, Accountant; and to the entire committee chaired by Mr. Peter L. Cappuccilli. The Project Engineer for the evaluation study and report was Mr. William H. Hughes, assisted by Mr. S. Davis Stinson and Mr. Jack B. Frysinger of Konski Engineers, P. C.

KONSKI ENGINEERS, P. C.

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EVALUATION OF SHREDDING FACILITIES
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY, NEW YORK

FINAL REPORT

SUMMARY OF FINDINGS

1. Key to a successful shredding operation and high production rates is materials flow and proper maintenance.
2. Shredder discharge particle size got larger as wear on the ring type grinders increased. Fineness of the shredded product also varied with the composition and moisture content of the waste.
3. Facility noise levels in some locations were found to exceed limits currently considered by OSHA as indicating danger of hearing loss through prolonged exposure.
4. Positive dust collection system desirable in the shredding room of the facility.
5. Areas of the shredder that require continual rebuilding against wear should be easily accessible and/or have easily replaceable parts.
6. Jams in the shredder and in the conveying system are the prime causes of delays.
7. Restrictive bar on in-feed conveyor minimized blockage and provided for more uniform flow.
8. Size reduction of the baffle plate at the discharge chute minimized blockage.

9. Height of opening at end of output conveyor was increased to minimize blockage.
10. Christmas trees or large quantities of cardboard and paper should be mixed thoroughly with conventional waste before being fed into shredder.
11. The more the incoming waste is mixed the better the flow.
12. Refrigerators, stoves, washers and dryers can be used to clean out the shredder and to keep the ring type grinders from binding.
13. Due to improved welding techniques, breaker bar life increased.
14. Materials flow interruption time is about 75 per cent of total down time or non-production time.

RECOMMENDATIONS

1. Due to construction problems, shredder manufacturer should sell equipment as a package, from in-feed conveyors through transfer conveyors.
2. Larger tipping floor.
3. Remove oversized material from feed streams.
4. Schedule private haulers for less interference with city refuse trucks.
5. Care must be taken to insure that paint thinners, flammable paints, gasoline cans, or propane tanks are not fed into the shredder because of the danger of explosion and fire.
6. Schedule and religiously perform preventative maintenance as required.

INTRODUCTION

The solid waste problem had become critical in Onondaga County just as it had in the rest of the country. The generation of solid waste has increased considerably due to increased urban population densities, increased use of packaging materials, shut-down of on-site incinerators to meet air pollution control laws, increase in consumption and shorter useful lives of consumer goods. It appears that this trend will continue far into the future. There is also a sharp decline in available urban land areas for disposal sites due to: (1) difficulties in finding large areas of undeveloped land for sanitary landfills in urban areas, removed from residential areas and satisfying necessary criteria to prevent ground water pollution, and due to (2) public resistance to shipping solid waste to disposal sites across municipal boundaries.

The Metropolitan System for Solid Waste Disposal in Onondaga County had its beginnings with a special Citizens' Committee in 1967. Onondaga County Executive John H. Mulroy appointed this committee to review the solid waste situation and to recommend a solution. The Committee reviewed five basic disposal methods. They were: incineration, composting, baling, pyrolytic destruction and landfill. They also reviewed an intermediary step, that of milling of refuse. The Committee recommended that an Authority be established by State Law and that land-related disposal be practiced with the pretreatment of solid wastes by shredding. The Committee felt that the change in character of solid wastes brought about by shredding would alter completely the pattern of acceptance by the community of its own solid wastes under controlled conditions. The characteristics of milled refuse that make it more acceptable are that it is homogenous, it minimizes rodent and insect vector problems, it tends not to blow in the wind, it does not readily support combustion, has little odor, may require less cover, appears to be more easily handled than the raw product and produces less wear on equipment.[1]

The Authority was duly created by the New York State Legislature in 1969 upon request of Onondaga County officials and the County Government loaned initial monies to the Authority to commence operation. The Authority does not have taxing powers, it relies on service charges and grants for income. Since the initial problem was the disposing of the City of Syracuse's solid wastes, joint discussions were held with the City Administrators and Legislators. In 1970 Mayor Lee Alexander proposed that a joint venture be undertaken whereby the City would underwrite construction of the first plant and in return the Authority would operate its shredder therein. A contract was entered into following this plan and the site selection process began with the aid of the design engineers, Konski Engineers, P. C. of Syracuse, New York. Several sites were evaluated and one was finally selected near an existing City landfill. Access to all City areas as well as the landfill by existing and proposed expressways together with the relative isolation from surrounding land uses make the location ideal. Solid wastes are transferred and shredded at this site.

The Plant is located on Rock Cut Road in the Town of Onondaga, County of Onondaga, State of New York, and is situated in the southern part of the metropolitan area, south of the City of Syracuse and approximately five miles from the center of downtown Syracuse (Figure 1). The entrance to the sanitary landfill in which the shredded waste is presently disposed is approximately one mile from the plant.

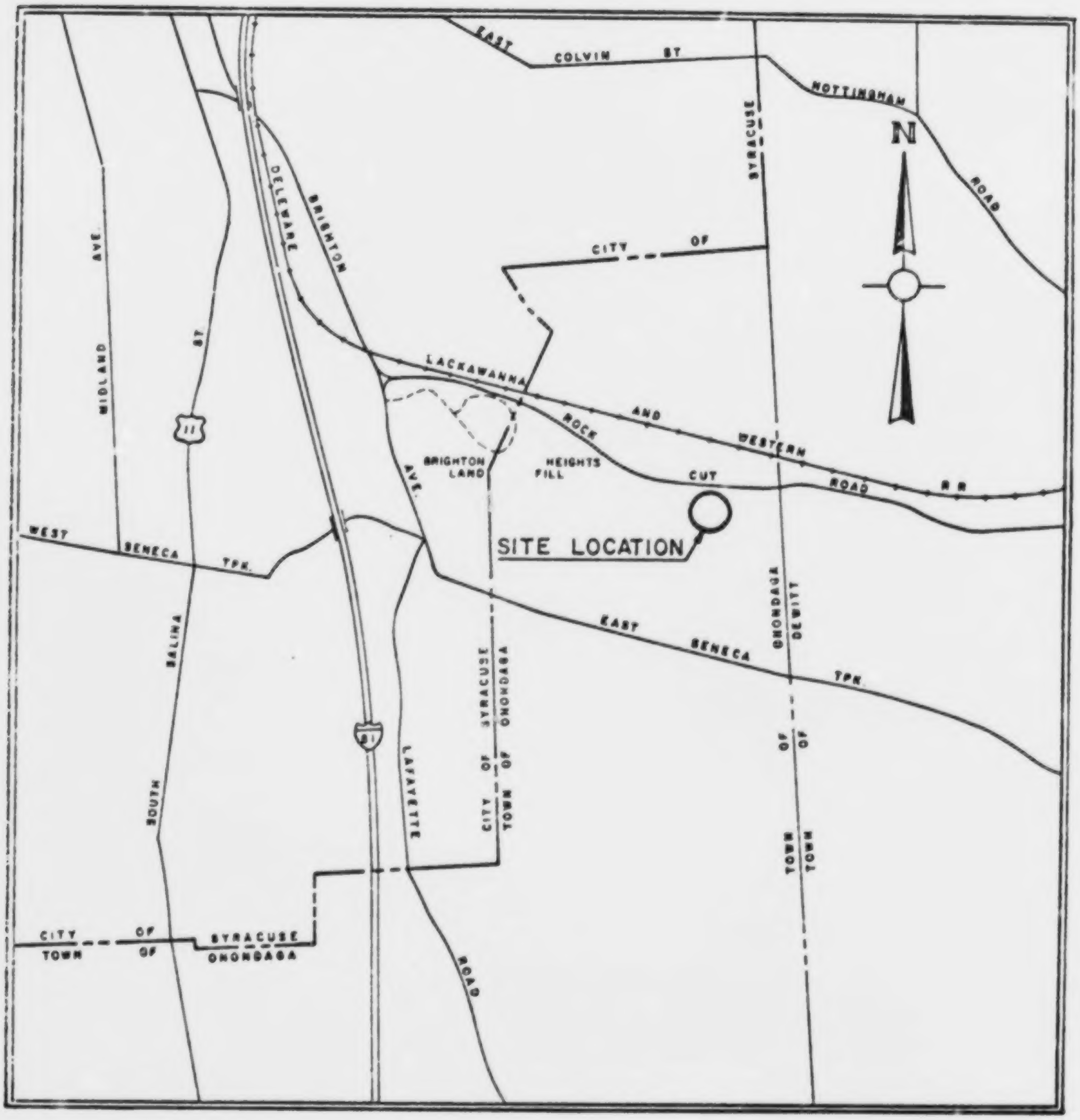

FIGURE 1. Location Map

The sanitary landfill is operated in accordance with the New York State Sanitary Code. Unprocessed refuse is compacted and covered daily with six inches of cover material, twelve inches of intermediate cover is used, and at least two feet of final cover is placed on completed portions of the landfill. Part 19-Refuse Disposal and Part 190-Open Fires of this Code are included in Appendix A.

The Solid Waste Mill Facility was designed by the engineering firm of Konski Engineers, P. C. of Syracuse, New York. Special consultants to Konski Engineers were Witt and Van Keuren, Architects, and Robson & Woese, Inc., Mechanical and Electrical Engineers. Konski Engineers also furnished full time inspection services during the construction period.

Contracts were let in May 1972. Contracts were awarded to The Visconti Corporation of Solvay, New York, for General Construction; to Kenneth A. Taylor, Inc. of Syracuse, New York, for Heating, Ventilating and Air Conditioning; to H.H.&F.E. Bean, Inc. of East Syracuse, New York, for Plumbing and to the Kay-R Electric Corporation of Syracuse, New York, for Electrical Work.

The major equipment package consisting of the Eidal Model SW-1150 Shredder, the infeed conveyor, discharge conveyor and the transverse conveyor was ordered by the Authority in the Spring of 1972. This equipment was delivered in the Summer of 1972.

Plant construction began in June 1972. Sitework, piling, concrete foundation work and water line installation proceeded throughout the Summer and early Fall of 1972. The shredder was installed in September 1972 and the structural steel framework for the building was completed in October 1972. The erection of the precaste concrete wall and roof panels was completed in January 1973, the exterior siding in February 1973, the membrane roof and the interior siding in March 1973, and installation of steel overhead doors and concreting of the dump floor was completed in April 1973.

Installation of the infeed conveyor commenced in October 1972 but due to misfit problems and missing parts was not completed until July 1973. Installation of the discharge conveyor and the transverse conveyor commenced in May 1973 and was completed in early September 1973.

The compactor units and the push pit equipment arrived in May 1973 and installation was complete and checked out by early September 1973.

Installation of the electrical sub-station and switch gear was completed in August 1973, and power to the plant was activated in August 1973 by the Niagara Mohawk Power Corporation. The electrical checkout by the electrical contractor and General Electric Company, who furnished much of the electrical switch gear as well as the shredder motors, was completed in August 1973.

Numerous problems delayed construction of this facility. Right of entry into a portion of the site at the east end was not obtained until early October 1972. While this did not delay construction of the plant itself it did delay the site work. In his foundation work the Contractor encountered a very high water table. This, coupled with a record high rainfall in 1972, also delayed construction. In addition, all the prime contractors and their sub-contractors experienced some delays in obtaining materials. For example, exterior siding did not arrive until January 1973, seriously delaying interior work. The electrical switch gear did not arrive until March 1973, seriously delaying the electrical contractor. The shredder motor-starter units were damaged in shipment.

The Authority chose to have a single contractor supply all of the major equipment package for the demonstration project and allowed him to select his own subcontractors. There was poor coordination between the prime contractor who supplied the shredder and his subcontractor who supplied the conveyors and the conveyor support systems. Various components of the major equipment package didn't integrate and portions of the individual components were missing and other portions were mismatched, requiring much field renovation. The infeed conveyor arrived overwidth. It did not fit into the push pit area nor into the shredder hood. In order to install this conveyor, modifications were required both to the entrance to the push-pit area and to the shredder hood. The structural supports for the transfer conveyor were larger than the preliminary layout drawings indicated, requiring modifications to the support system in order to place the structural supports in proper position. This caused major problems. The infeed conveyor was approximately fifty per cent heavier than indicated by preliminary data received from the supplier. The output and transfer conveyors were also slightly heavier than listed. This overweight required the erection subcontractor to furnish much heavier equipment than originally contemplated and caused further delay in completion of the project.

The contractor for the General Construction Contract of the Solid Waste Milling Facility who was required by his contract to install this major equipment package incurred extra costs in the neighborhood of $30,000.

The Authority also had to make some renovations to the major equipment package. Side plates, 36 inches high by 12 feet long, were placed on the top of the 30 inch high side skirts of the infeed conveyor at the lower end to prevent refuse from spilling onto the floor. Additional catwalks were installed alongside all of the conveyors.

Each of the above problems contributed to a delay in the completion of the project. The delays were compounded by some Contractor inefficiency.

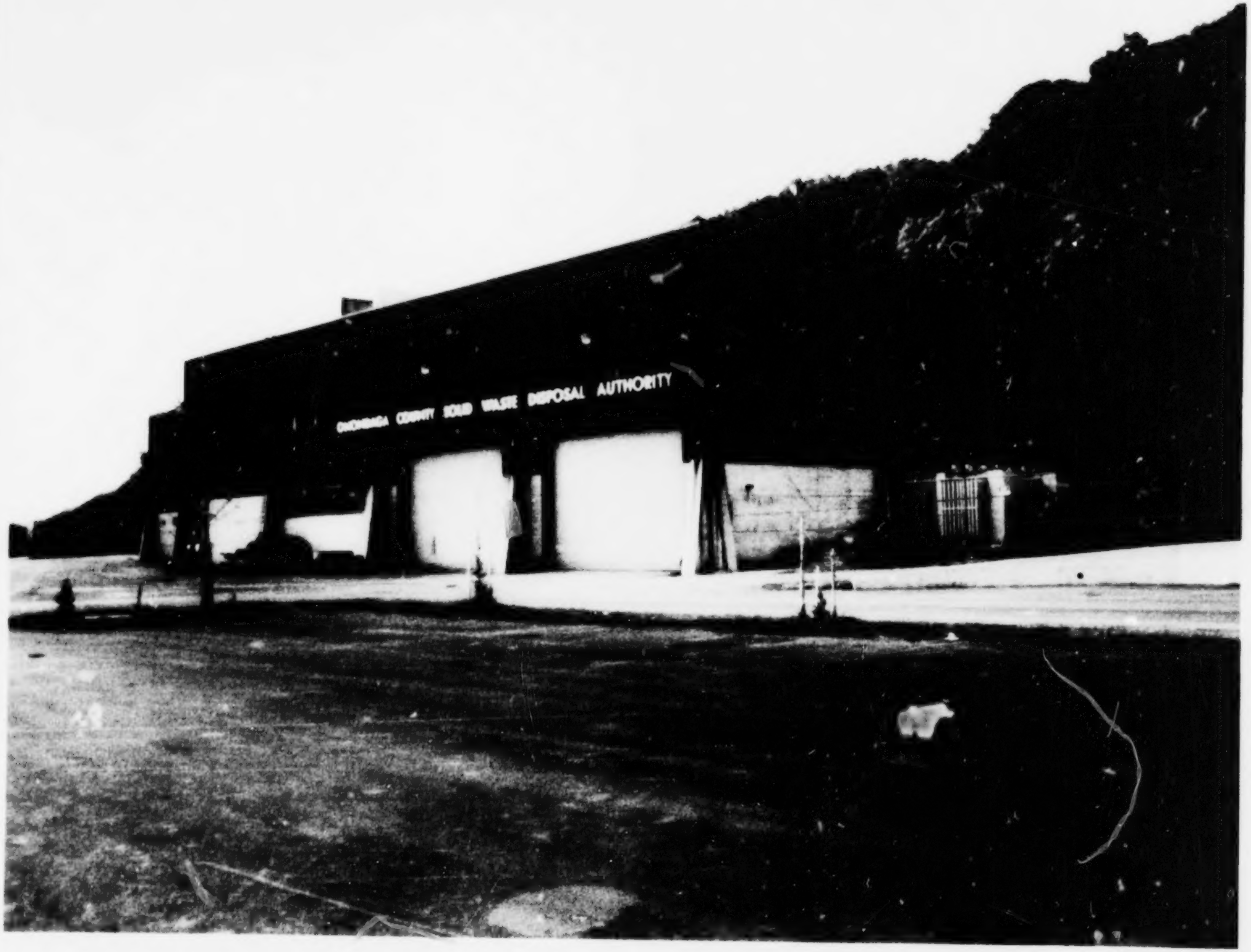

FIGURE 2. Onondaga County Solid Waste Milling Facility

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DESCRIPTION OF PROCESS

Refuse material processed in the solid waste milling facility is mainly ordinary packer-truck refuse as picked up at curbside by the City of Syracuse Department of Public Works crews and private contractors outside the City. Rubbish, including "bulky waste", such as furniture, tires and similar refuse and waste normally collected, can also be processed. No attempt is made to segregate incoming wastes except for unusually large pieces of solid metals, large hot water tanks, large truck tires, concrete or the like. These are picked out prior to shredding and taken directly to the disposal site. Unusually large concentrations of chemicals, paints and especially highly combustible wastes are not processed at this facility.

Incoming solid waste is hauled to the transfer process station in standard refuse compactor trucks. All loads are weighed on a truck scale. The trucks back into the shredder building unloading alternately into either of two push pits, which provide storage for uniform feeding of the shredding equipment. When the push pits are full the trucks unload on the dump floor. A rubber tired loader then loads a pit soon as it is empty. Solid waste is transferred from the pits to the infeed conveyor by hydraulically operated ram devices.

The pits are each 10 feet wide by 11 feet deep by approximately 37 feet long, and are constructed of reinforced concrete with guide rails to control the motion of the ram. The hydraulic system is under the control of an operator in the control tower. The pits operate alternately, one receiving refuse while the other is discharging to the apron conveyor. The refuse is fed continuously onto the apron conveyor, and then into the shredder.

The refuse received from the apron conveyor is shredded, reduced in size and discharged directly to a belt conveyor. The shredder is top-fed into the annular space between a vertically mounted rotor and a stator shell. The shell is tapered to present a decreasing dimension to waste passing down through the machine. Shredded material is swept out of the machine in a horizontal plane by sweep arms mounted at the bottom of the rotor (Figure 3).

The vertical rotor is made up of a breaker bar (Figure 4) at the top entry and 60 ring type grinders mounted in pairs on the periphery of several horizontal discs (Figure 5) along the depth of the rotor above the sweep arms. The ring type grinders weigh approximately 64 pounds each (Figure 6). They are of hardened steel with a specified minimum surface hardness of 50 Rockwell C. The pins which provide the axis for the ring type grinders are of high strength steel with a specified minimum yield point of 90,000 PSI. The grinders are free floating because there is a pin-to-grinder clearance of 1 1/2 inches. This clearance allows the ring grinders to move outward under the influence of centrifugal force.

The rotating breaker bars perform the initial size reduction through a tearing action. The refuse flows downward due to the force of gravity and the pushing action of new materials being forced in on top. The refuse is gradually reduced in size by the action of the 60 free-floating ring type grinders attached to the rotor assembly, working in combination with fixed vertical wear bars projecting out from the replaceable liner plates. Additional reduction is achieved by the movement of the waste materials themselves working against one another.

The shell of the shredder is a 12 sided polygon (Figure 7) in cross section with sides converging downward. It is equipped with heat treated liner plates held in place by high strength liner bolts. Replaceable liner plates fit on

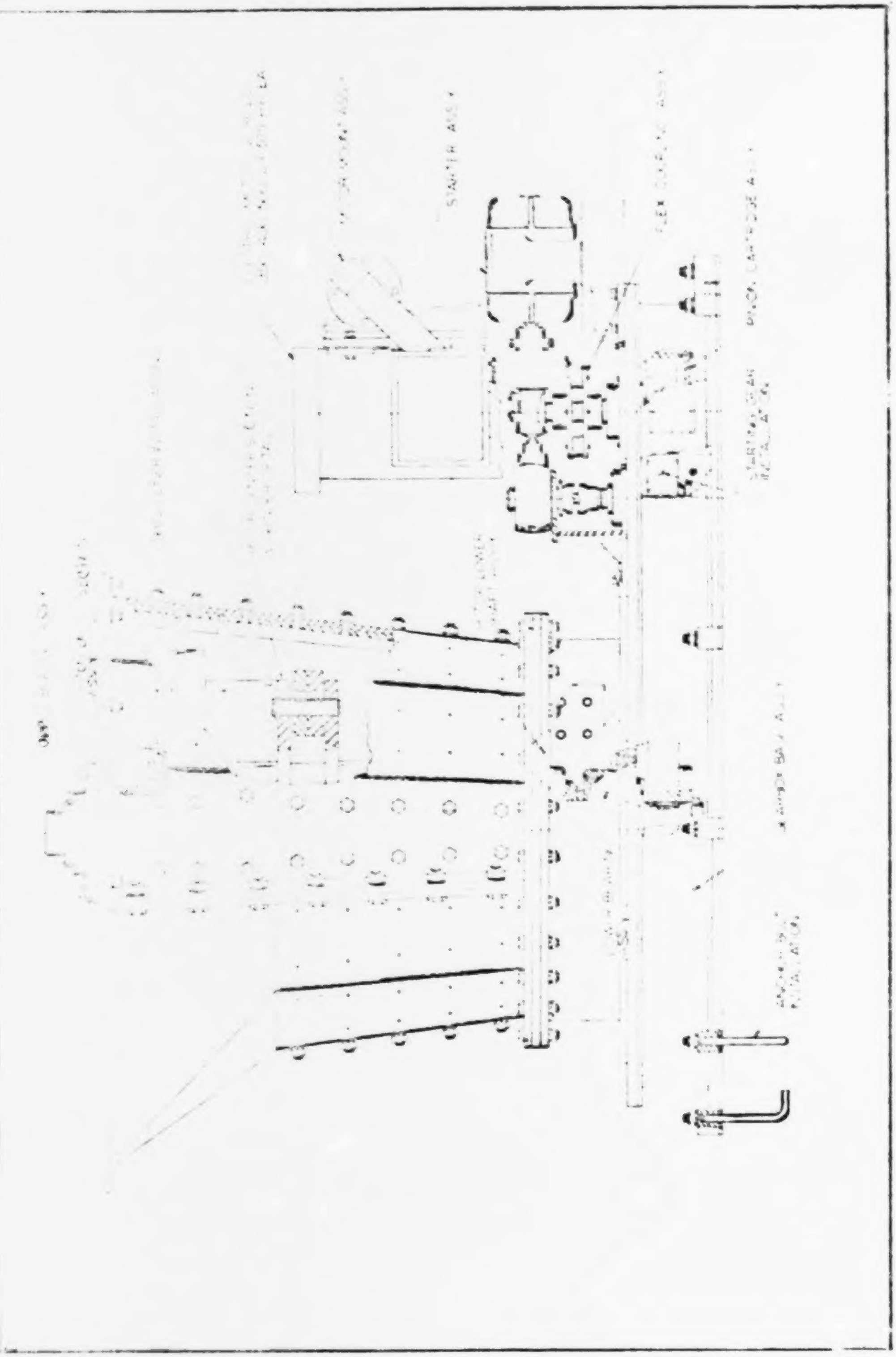

Figure 3. EIDAL SHREDDER

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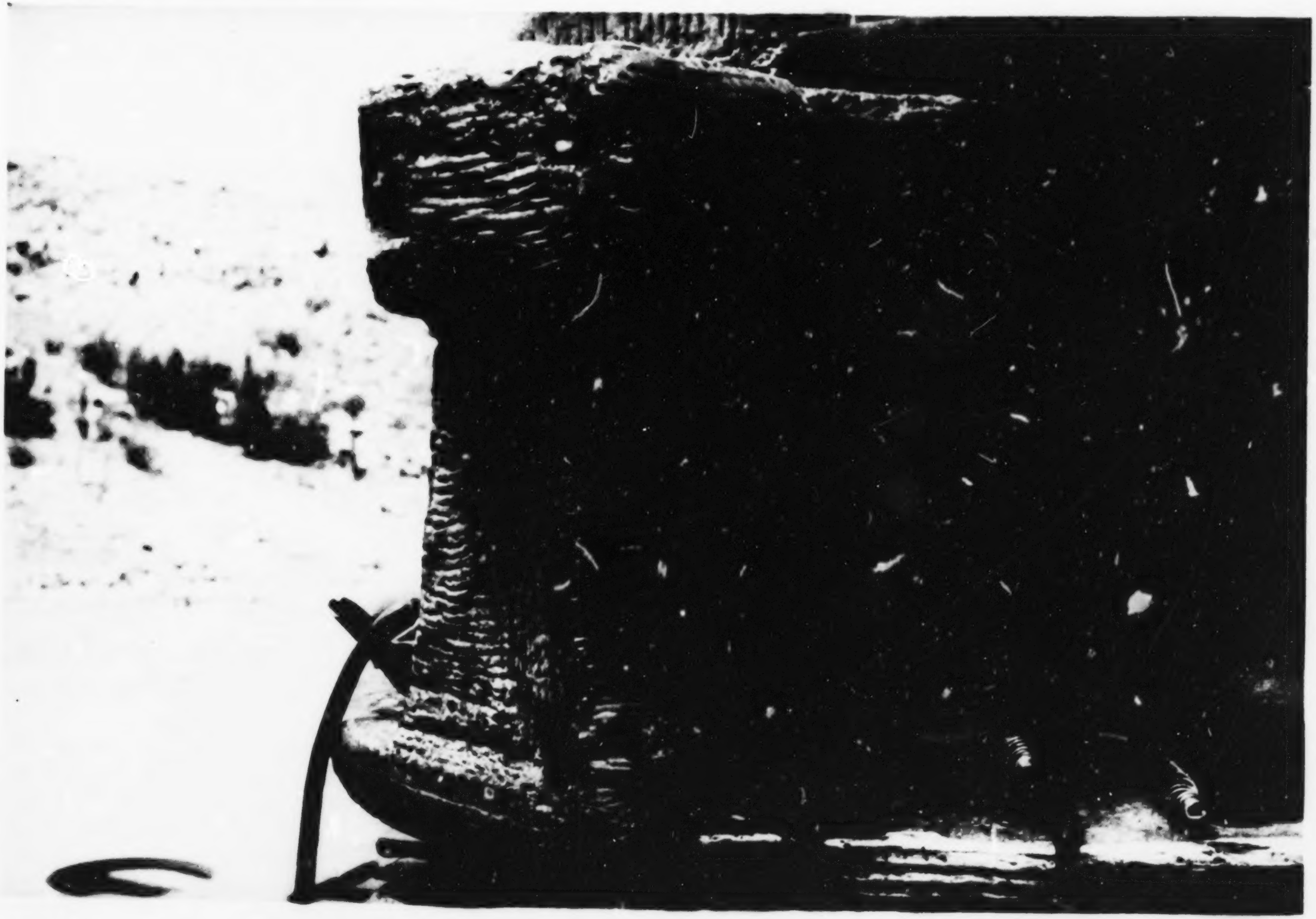

FIGURE 4. Breaker bar.

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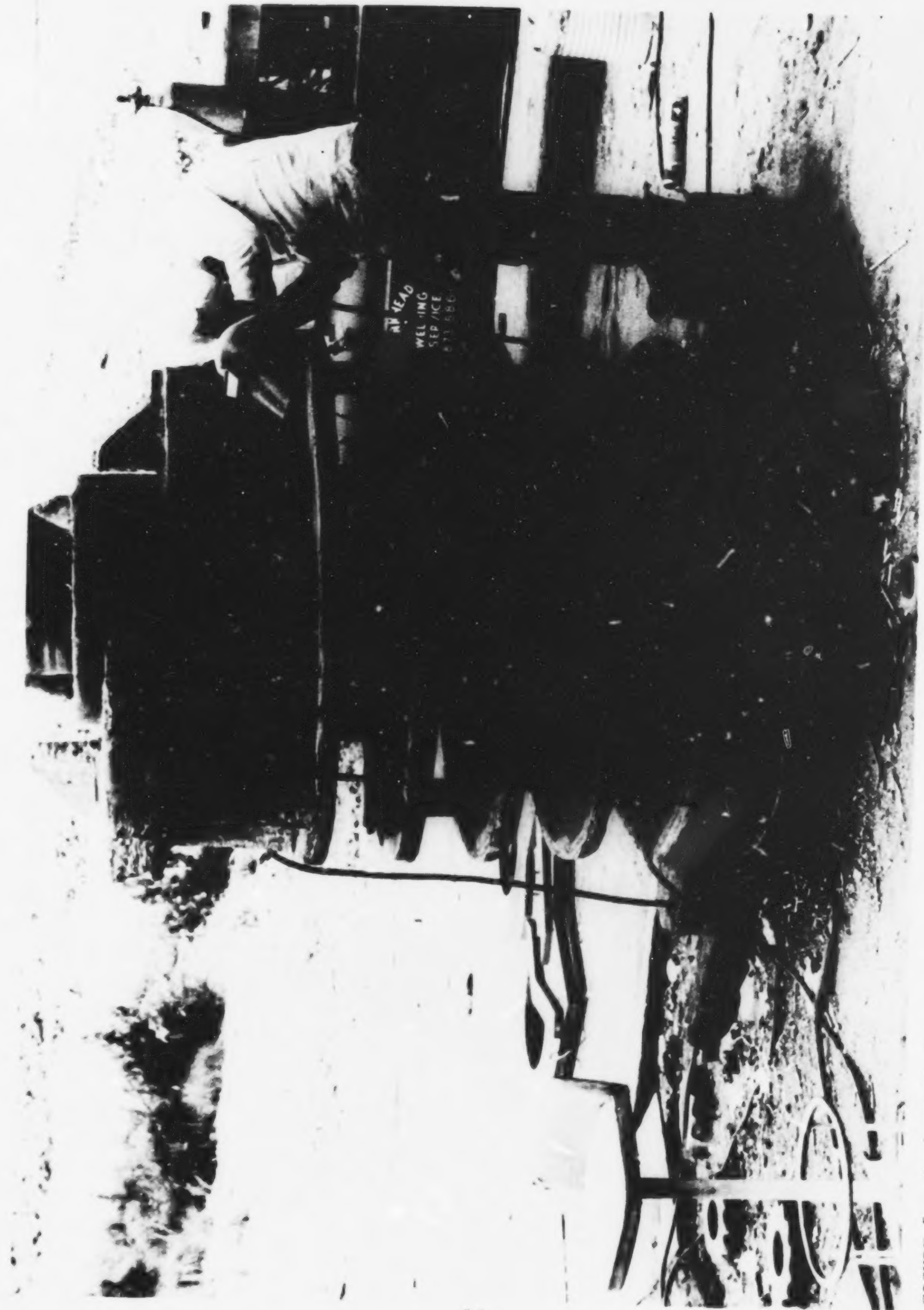

FIGURE 5. Horizontal disc.

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FIGURE 6. Ring Grinders.

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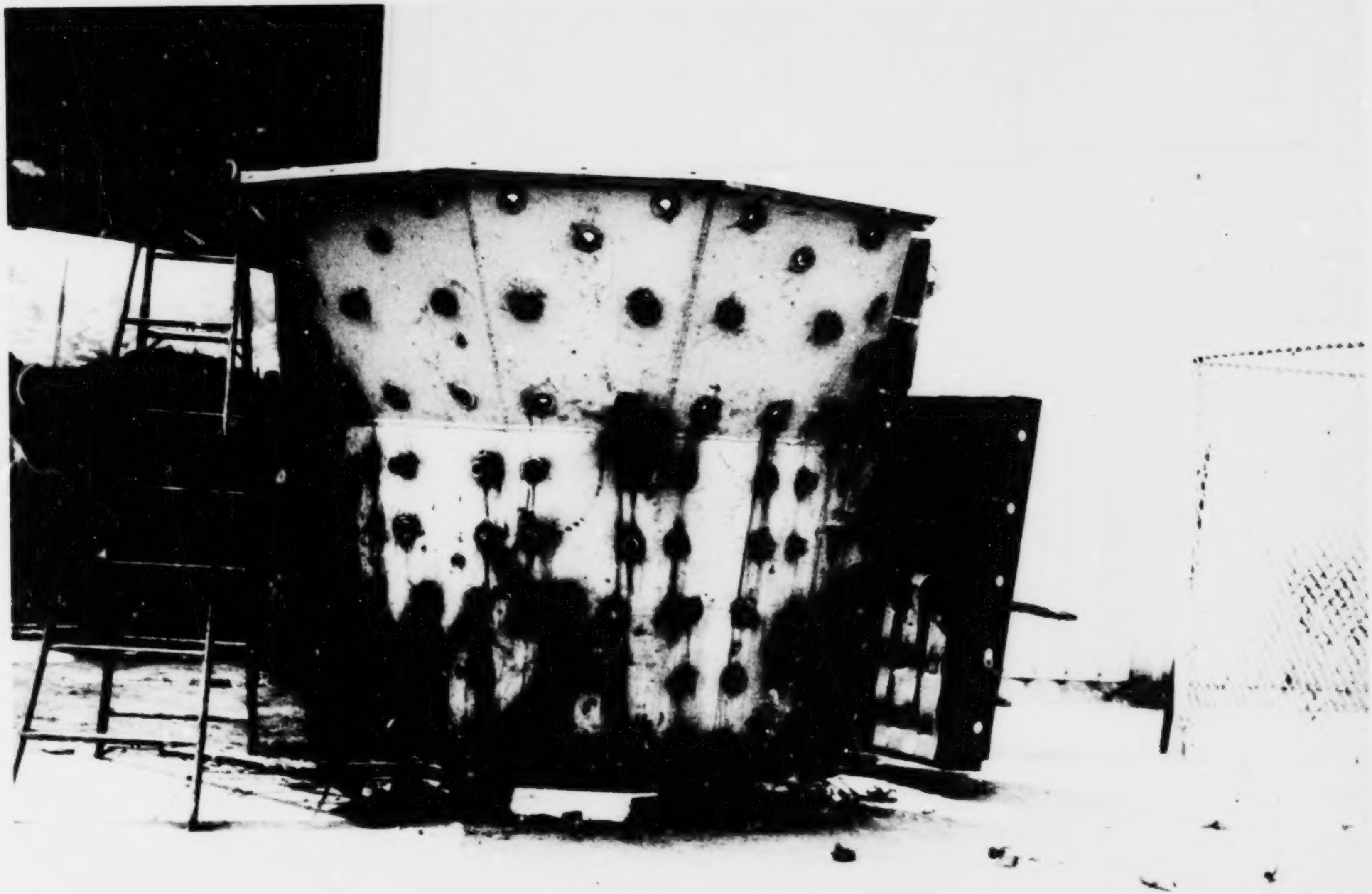

FIGURE 7. Outside polygon shell.

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the flat faces of the inside of the shell so that they are completely locked in place by the geometry of the shell. The shell is equipped with a removable bolted door for easy inspection and maintenance. The steel shell is one inch thick and the replaceable liners are also one inch thick.

The shredder is equipped with a horizontal gear drive train with a final gear mounted directly on the shredder rotor. The gear drive is enclosed and is equipped with a spray type lubrication system. All drive components are mounted on heavy duty anti-friction bearings.

The two main motors are foot mounted suitable for vertical shaft down operation. They are of open drip-proof construction. They are nominal 500 HP, 1800 RPM, with a 300 per cent breakdown torque for operation at 2300 volts, 3 phase, 60 HZ. They are direct coupled to the drive gear train through flexible couplings. The shredder is equipped with a 75 HP starting motor, coupled to the drive train through a flexible coupling, right angle gear box and one-way clutch to remove the high starting interia from the main motors. The starting motor is capable of accelerating the shredder to motor shaft speed of 1260 RPM in 2-1/2 minutes. The starting motor is of open drip-proof construction, 1800 RPM, for use at 460 volts, 3 phase, 60 HZ.

The output belt conveyor receives shredded waste from the shredder and transports it to the transfer conveyor (Figure 4). The reversible transfer conveyor receives shredded waste from the belt conveyor and transfers it alternately into one of two stationary compactors. The compactors receive shredded material from the reversible conveyor and discharge that material into 40 CY compactor trucks. The compactor ram mechanism is capable of developing compaction forces in excess of 90,000 pounds. Automatic latching and locking devices secure the trucks to the compactors during loading.

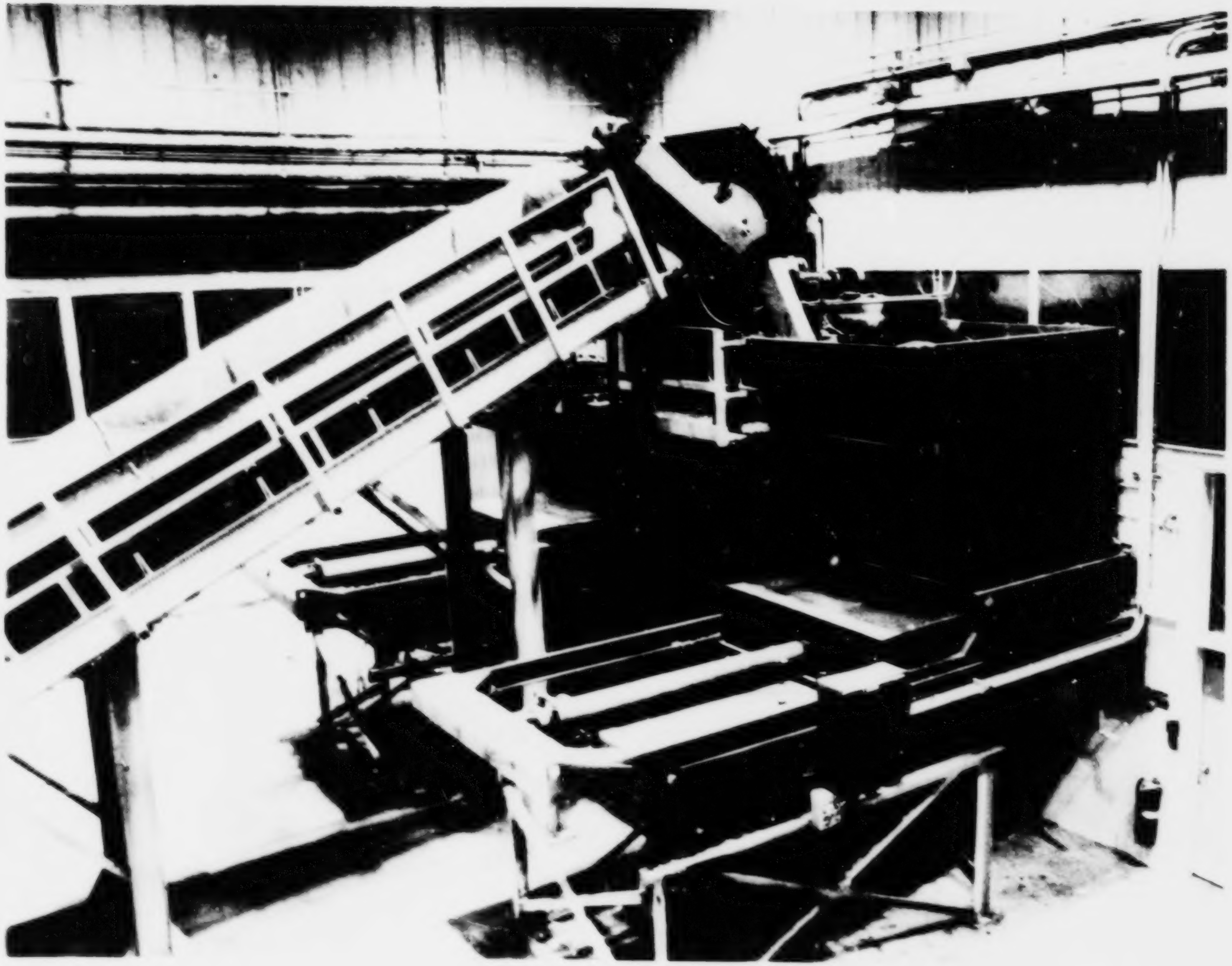

FIGURE 8. Transfer Conveyor and Stationary Packers

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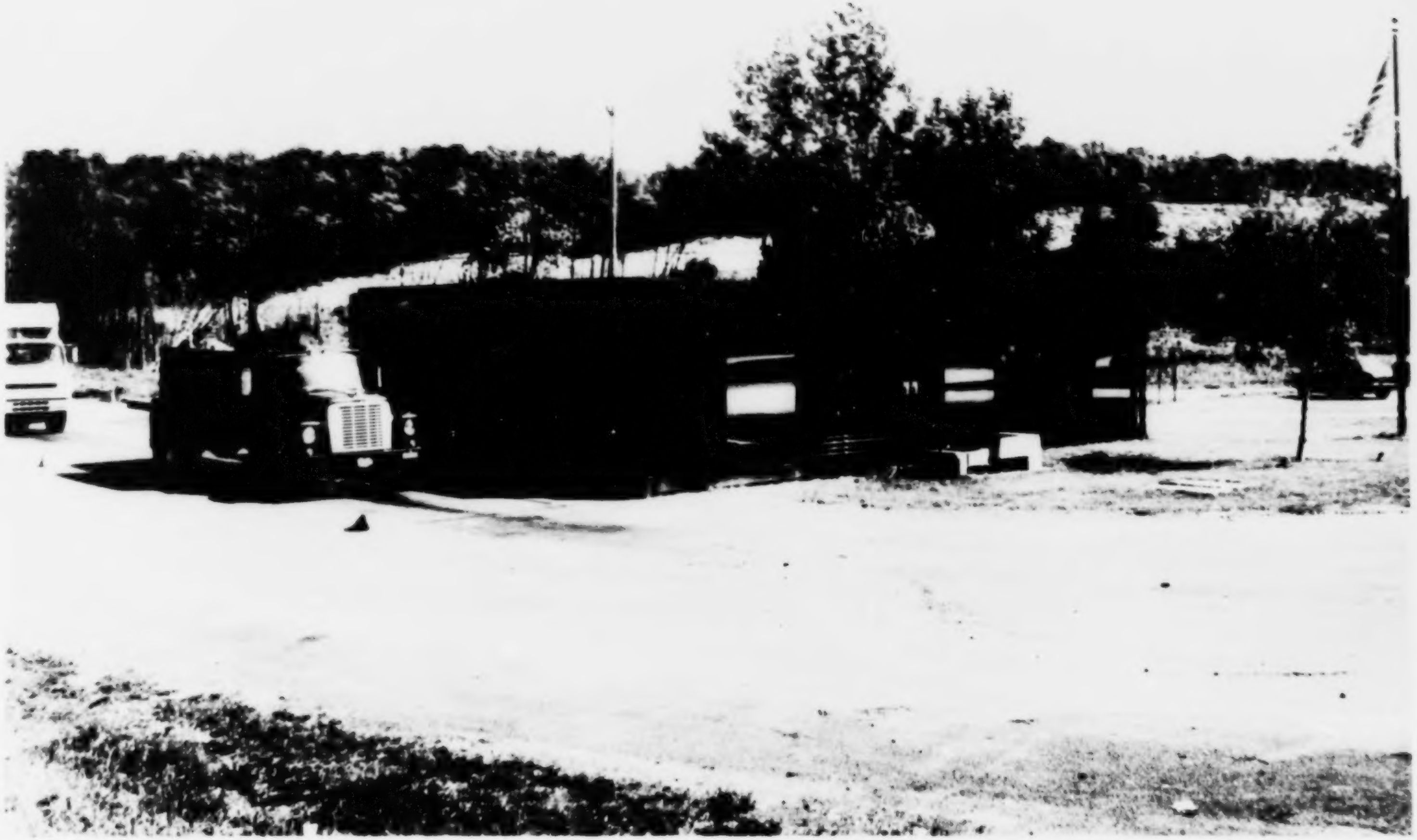

FIGURE 9. Scale House - Office Building

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The shredded solid waste is then transported to the Brighton Heights Sanitary Landfill for final disposal.

The shredder building (Figure 2) is approximately 104 feet by 128 feet in plan. It has a concrete foundation built on pipe piles driven to bedrock and a steel frame with metal siding upper walls and precast concrete plank. The building has an office area approximately 32 feet by 67 feet which includes a lunch room, utility room and lavatory facilities. Electrical switch gear is housed in a room over the office.

The scale house-office building (Figure 9) is approximately 32 feet by 48 feet in plan and also was built with a steel frame on a concrete foundation. It has metal sandwich panel walls and insulating glass windows full height. The offices for the Onondaga County Solid Waste Disposal Authority are contained herein in addition to the scale house and record keeping facilities.

Description of the major equipment package is as follows:

Shredder: Eidal International Corporation, Albuquerque, New Mexico. Model 1150, design capacity (conservatively) 40 tons per hour when shredding normal domestic wastes. Size 8 feet by 13 feet by 19 feet high. Total weight approximately 54 tons. Rotor weight 17 tons, speed 369 rpm. Powered by two nominal 500 HP motors operating on 2300 volts A.C. Originally designed to shred automobiles. This shredder is now manufactured by Pangborn Division of Carborundum Environmental Systems, Inc., Hagerstown, Maryland.

Infeed Apron Conveyor: Iron Hustler, Division of Maple City Stamping Company, Peoria, Illinois. Steel belt conveyor about 52 feet long center to center head and tail pulleys. Inclined at an angle of 30 degrees. Width 6 feet face to face of side skirts. Apron plates are 1/2 inch thick with piano hinges formed into edges. Hinge pins $1\frac{1}{2}$ inch diameter bar stock. Operating speed 33.4 feet per minute. Approximate weight 70,000 pounds.

Output and Transfer Conveyors: Iron Hustler troughing flexible belt conveyors with 48 inch wide by 15/16 inch thick fabric reinforced synthetic rubber belts. Discharge conveyor is approximately 39 feet center to center pulleys and inclined at an angle of 24 degrees. Rated operating speed 150 feet per minute. Weight about 10,000 pounds. Transfer (reversible) conveyor is approximately 14 feet long center to center pulleys. Level. Rated operating speed 170 feet per minute. Weight about 5,000 pounds.

SHREDDERS, USES AND FUTURE

Uses for Shredder

The major uses of solid waste shredders has been for size reduction before landfilling, size reduction during composting, size reduction prior to incineration and size reduction in a resource recovery process.

Size Reduction Before Landfilling. Shredding municipal refuse as a processing step in solid waste management may appear to be a needless operation. However, a significant improvement in refuse as a disposal item in a sanitary landfill is obtained by the shredding operation.[5]

The shredded material is homogeneous. That is, most of the shredded material has lost its identity as ordinary refuse. It looks like shredded paper or oversize confetti. The shredded material is easier to distribute and compact at the landfill, and makes possible a more uniform landfill density. Blowing papers and housekeeping problems at the landfill are minimized. The shredded material has almost no odor, it does not readily support combustion, and is not attractive to rodents and insects. There is apparently an increase in density in compacted shredded material as compared with unshredded refuse and the shredded material does not need to be entirely covered with earth on a daily basis. Since this would reduce the volume in the landfill, a more efficient utilization of land is possible and there is a savings in cover material costs.[10]

Since most of the shredded material has lost its identity as ordinary refuse, there is less adverse public reaction to proposed disposal sites. Thus a landfill site can be located nearer to populated areas with less complications, affording savings in transportation costs. The problem of educating the public to accept these facts still remains, however.

Land that is now otherwise unusable can be reclaimed. Quarries and exhausted sand and gravel pits could be filled and converted to useful lands. Borrow pits from which fill is removed to build highways, could enter the program of reclamation. Ravines could be filled if not carrying substantial amounts of water. (Drainage pipes would be placed in the ravine before the commencement of landfilling.) Level land would then be made available for development of recreation areas. A pair of drumlins close together offer some possibilities: the entire area between them could be filled, with the cover materials coming from the drumlin, and this whole landform could be transformed into useful land for development. A variation on this could be the establishment of a whole new concept of outdoor winter recreational activities such as snowmobile and ski trails.[1]

The shredding process offers some advantages when properly applied to specific situations, especially when the intangibles in solid waste management are considered. It offers its greatest advantage where cover material is scarce or costly. In all cases, the benefits must be balanced against the additional cost of shredding and the potential for generating the same problems common to ordinary landfills.

There are some disadvantages or problems associated with the use of shredded refuse, also. Shredded refuse has as great a potential for water pollution, both by leachate and direct pollution, as other refuse not covered and graded. Uncompacted shredded refuse has a low density. It must be transported to the fill area and thoroughly compacted to obtain full advantage of the process.[10] The exposed surface of the shredded refuse will absorb most of the moisture falling upon it. Field capacity tests have been made on ground refuse in research at Drexel University. (Field capacity is defined as the maximum moisture content which a soil or refuse can retain in a gravitational field without producing significant leachate.) These studies found that as refuse size decreases, the field capacity increases significantly. It was concluded from these studies that grinding of refuse greatly increases field capacity thus retarding the first appearance of leachate from a landfill constructed of ground refuse.[4]

Size Reduction During Composting. In the past the most extensive use of size reduction equipment has been in the preparation of compost. Most composting processes in use today require some sort of size reduction. Particle size must be reduced to facilitate handling, digestion and mixing of the materials in the composting process. However, composting in the United States has enjoyed little commercial success primarily because of excessive operating costs and lack of substantial markets.[5, 7]

Size Reduction Prior to Incineration. Size reduction equipment has been used as an accessory operation for incineration. In the past, size reduction has been used for the reduction of large appliances and bulky items prior to incineration. These wastes are often too large for direct charging, they burn too slowly and contain some non-combustible portions.[5]

Incinerators have been designed specifically for burning shredded refuse. Raw refuse is a heterogenous material with its constituent parts having a widely-varying heating value. When unshredded refuse is burned, hot spots occur which contribute to tube corrosion and slagging on the furnace walls. In order to reduce these hot spots, many incinerators operate with large amounts of excess air necessitating larger air pollution equipment. Refuse that is shredded and then suspension fired is converted from a heterogenous to a homogenous fuel.[7] Certain advantages accrue from shredding and suspension firing: refuse handling can be done by conveyors, thus eliminating overhead cranes (conveyors generally have a more uniform feed rate); incinerators can operate with less excess air, thus furnace size and air pollution equipment sizes are smaller with attendant cost savings; more complete combustion is obtained.[7]

Size Reduction in a Resource Recovery Process. Many resource recovery processes require shredding of the refuse as a step in the system. Separation equipment available today generally requires that the refuse fed to it be homogeneous and not exceed a certain top size. Unshredded refuse would require larger separation equipment and since it is not homogeneous and moisture is not distributed evenly throughout, materials would tend to cling together and block proper operation of such equipment. A more complete recovery of resources, such as glass, aluminum and ferrous can be obtained with shredding as an initial step in the process.[7]

As noted previously size reduction equipment has been used as an accessory operation for incineration. Recovering the heat generated by incineration is another resource recovery process. Shredded refuse can be used as a supplementary fuel or as the primary fuel.

There are several advantages to a waste heat recovery system. Burning shredded refuse for its fuel value provides a useful application for what is now being discarded. Heat recovery incineration is less expensive than conventional incineration. The size of air pollution equipment required is smaller since less excess air is required and the volume of gas that must be cleaned before it is exhausted is reduced. Refuse is a low sulfur fuel, so sulfur oxide emissions would be reduced. This also reduces the required size of air pollution equipment. Conventional fuel consumption would be reduced thereby conserving some of our national resources.[5, 7]

Heat recovery incineration is a viable process. Power plant boilers that are fueled by pulverized coal can be adapted to permit the firing of shredded refuse as a supplementary fuel.[11] However, there are some added costs for the heat recovery equipment and for extra maintenance. The supply of refuse is variable as well as the heat content which makes for some difficulty in matching the supply to the demand. Therefore, the best use for this type of heat recovery incineration would appear to be in conjunction with, or an addition to, an existing system.[5]

Pyrolysis is a process often referred to as destructive distillation, through which materials break down into simpler compounds and elements by means of heating in either an oxygen-free or low-oxygen environment. The products of pyrolysis are solids, liquids and gases.

A pyrolysis system has been developed by the Garrett Research and Development Company of LaVerne, California to handle municipal refuse. The system uses primary shredding as an initial step to reduce the refuse to a two inch particle size, and secondary shredding after air classification, drying, screening, magnetic separation and froth flotation to reduce the material to No. 50-mesh-size particles. A two hundred ton-per-day solid waste pyrolysis plant is being designed and is to be constructed in San Diego County, California.[7]

Future of Shredders

Future Market. The future market for solid waste shredders appears to be very good, and it would appear that their greatest use may well be in the resource recovery process.

Size reduction or shredding before landfilling is being used today in many locations. It will continue to be used particularly in areas where cover material is scarce. Where disposal sites must be located close to populated areas it will be used simply because of the more desirable properties of shredded refuse in comparison to the raw or unshredded product.

The use of shredders to implement the resource recovery process will probably grow, both in front end and back end materials recovery systems. A front end recovery system provides only mechanical separation of materials without altering their physical properties. A back end system provides for the use in some productive form of the larger portion (approximately 85%) of the output that is left after preliminary mechanical separation.[7] As discussed previously, in a recycling process shredding of municipal solid waste aids in the separation process and a more complete recovery of resources can be obtained with shredding as an initial step in the process.

Economic policies, outmoded laws, and public attitudes now prevent recycled products from fulfilling their potential. It is sometimes more economical to use virgin materials than secondary raw materials due to depletion allowances and capital gains allowances. Secondary raw materials also suffer from discriminatory freight rates which in some cases are fifty per cent higher for recycled materials than for comparable virgin raw materials.[2]

It does not appear that there will be a significant demand for shredders in the composting process. Composting has had little commercial success in the United States. If composting can be made economical, and markets develop, there is a potential use for shredders in this process.

It would appear that the greatest use for shredders in the future will be in the process of conversion of municipal solid waste to energy. This can be in the form of either heat recovery incineration or pyrolysis. An energy recovery system is highly desirable. A product that is now being discarded can thereby become a useful product. Some of our dwindling natural resources could be saved by use of refuse as a source of energy, and the cost of municipal solid waste disposal reduced accordingly.[7]

There are problems to be sure. Many of the resource recovery systems are still in the developmental or pilot plant stage, while others that are operational have not been so long enough to iron out all the imperfections in their systems or to provide true long range costs.

Operational Problems. The shredder can process almost all municipal solid waste that is picked up at curbside by the City of Syracuse. All normal domestic waste including garbage, rubbish, household bulk wastes (such as chairs, tables, cabinets, stuffed chairs, sofas, hide-a-beds, innerspring mattresses, bed frames, bed springs, rolled carpets), small tree limbs (up to $1\frac{1}{2}$ inch), foliage, fences, flooring, sidings, doors, lumber, storm windows, screen doors, stoves, washers, dryers, refrigerators, plumbing fixtures, cast iron soil pipe, automobile fenders, hoods, automobile tires with or without steel wheels, steel bolts, bars, angle iron (up to $1\frac{1}{2}$ inch) and strapping can be processed.

The shredder will also process commercial and industrial wastes including garbage, rubbish, construction debris, brush, pallets, and packaging materials.

There are some materials that can not be or should not be fed to the shredder. The physical size of items to be shredded is limited by the size of the feed opening of the shredder. Materials such as earth, rock, soil, sand, gravel, concrete, reinforcing rods, toxic or hazardous wastes, sanitary sewage wastes, hardened crank shafts and gears, truck tires, large hot water tanks and long pieces of steel cable have been found to jam the shredder. Crank shafts and gears will increase the wear on the shredder and will also jam the shredder.

Care must be taken to insure that paint thinners, flammable paints, gasoline cans, or propane tanks are not fed into the shredder due to the danger of explosion and fire.

These undesirable materials are usually hand picked from the dump floor or the infeed conveyor before they are fed to the shredder in order to eliminate potential problems or hazardous conditions.

CONCLUSIONS

Metropolitan System for Solid Waste Disposal

The Metropolitan System for Solid Waste Disposal in Onondaga County had its beginnings with a special Citizens Commitee in 1967. This committee, as indicated in the INTRODUCTION to the report, reviewed the solid waste situation and recommended that an Authority be established by State Law and that land-related disposal be practiced with the pretreatment of solid wastes by shredding. The committee felt that the change in character of solid waste brought about by shredding would alter completely the pattern of acceptance by the community of its own solid wastes under controlled conditions.

The metropolitan system for solid waste disposal in Onondaga County is still not a complete reality. Only the City of Syracuse and a handful of the seventeen towns that make up Onondaga County are using the Onondaga County Solid Waste Disposal Authority's facilities. However, this use is expected to increase. In December 1974 a second shredder facility adjoining the existing Rock Cut Road Plant was put into operation, thus doubling the capacity of the Authority's Rock Cut Road Plant to 80 tons per hour.

The County is constructing another shredder facility in the northern section of the metropolitan area. This 40 ton per hour facility is expected to be completed in late 1975 and will be operated by the Authority.

The additional shredding capacity provided by the completion of these plants will enable the Authority to handle much more of the County's solid wastes thus encouraging more of the towns in the County to use the Authority's facilities. The proliferation of landfills throughout the County will decrease as the Authority gradually takes over the responsibility for final disposal of the County's solid wastes. Sanitary landfilling should also become more economical as the Authority's regional landfills replace the numerous local landfills.

Thus, with the Authority gradually taking over responsibility for disposal of the County's solid wastes, it appears that the metropolitan system for solid waste disposal envisioned by the Citizens Committee could become a reality in the near future.

The metropolitan system for solid waste disposal was given a significant thrust towards fulfillment in September 1974 when Onondaga County revealed a feasibility study recommending the construction of a heat recovery incinerator/boiler plant to recover the heat content of municipal solid waste generated within the County.

The report recommended that a heat recovery incinerator/boiler plant be constructed adjacent to the existing Syracuse University steam plant, and that a central chilled water facility be constructed there also.

According to the report the plant would have the capacity to incinerate an estimated 1,000 tons of solid waste per day, recovering energy from the solid waste in the form of steam. The steam would be used directly for heating and would also power turbine-driven refrigeration machines to chill water for air conditioning. The proposed plant would supply heating and air conditioning to Onondaga County, Syracuse University and four hospitals.

The plan further proposes using the two shredding facilities as transfer stations for the northern and southern sections of the County and to shred bulky items. Two additional transfer stations are proposed for the eastern and western sections of the County.[3]

Additional studies are to be done on this system, and should show the advantages of converting refuse from a heterogeneous to a homogenous fuel by shredding and the suspension firing of the refuse. Shredding and suspension firing would require less excess air to operate the furnace, so furnace size and air pollution equipment would be smaller with corresponding cost savings. In addition, more complete combustion of the refuse would be obtained.

Operations

Production. The key to a successful shredding operation and high production rates is materials flow and proper maintenance. It has been found at the Syracuse, New York facility that the shredder can operate at peak capacity by keeping a constant controlled flow of solid wastes into the shredder and providing enough transfer vehicles to remove the shredded wastes as fast as they are processed.

The Eidal Shredder is rated conservatively at 40 tons per hour. The operational production rate for the shredder for the study year 1974 was an average of 47.8 tons per hour. The overall plant production rate for the same period was an average of 38.0 tons per hour. A total of 69,129 tons of refuse was processed in 1974.

In order to keep the production rates high it is also necessary that shredder downtime be minimized. During the study year 1974 the shredder plant was in operation an average of 7.5 hours per day, the plant operating time or "spin time" being defined as the time between initial start-up of the shredder to the shutdown at the completion of the production day. There was an average downtime or delays of 1.5 hours per day resulting in an average of 6.0 hours per day of actual production time. "Downtime" is defined as any time in which the shredder is not grinding refuse for any reason between the initial start-up of the shredder to the shutdown at completion of the production day (i.e.) any time the shredder is not processing refuse during normal working hours.

Discharge Particle Size. Generally, discharge particle size gradually got larger as wear on the ring type grinders increased. Gradation of the shredded product also varied with the composition and moisture content of the waste. A preliminary conclusion can be drawn to the effect that increased moisture content of the refuse results in a finer shredded product and increasing wear on the ring type grinders results in a coarser shredded product.

Moisture Content. The moisture content of the shredded refuse varied from 10.0 to 41.1 per cent with an average of 24.6 per cent. Early in 1974 the Authority discontinued adding water to the refuse. This action did slightly decrease the moisture content. However, refuse composition and the weather conditions prevailing during collection appeared to have more effect on refuse moisture content.

Facility Noise Levels. Noise levels at several locations in the plant were found to exceed limits currently considered by the federal government (OSHA) as indicating danger of hearing loss through prolonged exposure. The Onondaga County Solid Waste Disposal Authority has purchased ear-protective headgear for all employees, and rotates employees in those areas where the noise is excessive.

Dust Control. There is no dust collection equipment in the shredding area other than 1/2 inch mesh screening covering the outfeed conveyor, the transfer conveyor and the tops of the hoppers over the packers. The Authority felt that dust could be controlled by adding water to the refuse in the shredder. It was discovered, however, that adding sufficient water to control dust caused the ring type grinders to bind on their axles inducing uneven wear, and the use of water was discontinued. It now appears that a positive dust collection system would be very desirable in the shredding room of the facility.

Wear Rates. Wear rates have been found to be non-uniform. Areas subject to wear must be constantly inspected in order to catch the wear before it becomes a problem. In the shredder, the top breaker arms, the area under the top breaker arms, the separator rings, the bottom sweeper plates and the area of the shredder wall under the infeed conveyor are subject to considerable wear and must be continually built up and hardfaced.

Wear in the sweeper area of the shredder was so extensive that despite constant hardfacing holes were worn through the shredder wall. Access to this area for maintenance purposes was extremely difficult, so replaceable liner plates were eventually installed in this area.

Liner plates and ring type grinders are also subject to considerable wear and must be replaced periodically.

It is imperative that areas of the shredder that are subject to wear be constantly maintained. To ease the performance of this maintenance, areas of the shredder that require continual rebuilding against wear should be easily accessible and/or have easily replaceable parts.

Maintenance. In order to keep refuse production rates high it is necessary that shredder shutdown be minimized. Preventative maintenance must be scheduled and religiously performed as required. This includes lubrication and oil changes as well as repairs and replacement of worn parts.

Problems. The shredder can process almost all normal municipal solid waste from garbage to refrigerators. It is the small portion that can not or should not be processed that causes problems. Items such as gears, axles and large hot water tanks will not only jam the shredder but can cause severe damage.

Jams in the shredder and in the conveying system are the prime cause of delays and can be considered a major problem. Close attention must be given to proper feed rates, removal of non-shreddable materials before they reach the shredder and mixing of excessive amounts of paper and cardboard with other refuse. The Authority has found that the more the incoming waste is mixed the better the flow through the shredding operation. The mixing is performed with the pay loader on the dump floor.

Fires and explosions are another problem as mentioned previously. Care must be taken to insure that cans that may contain paint thinners, flammable paints or gasoline are not fed into the shredder due to the danger of explosion and fire. Propane tanks present a special hazard.

Power Requirements. During operational hours (the hours during which the shredder is operating), the energy consumption is 256 KW/Hour for the shredder, 75 KW/Hour for the motor control center, 36 KW/Hour for the shredder building and 23 KW/Hour for the scale house, for a total of 390 KW/Hour.

The average monthly kilowatt demand during the evaluation period was 594 kilowatts, the average monthly reactive KVA demand was 542 kilovolt amperes and the average yearly power consumption was 85,718 kilowatt hours.

Costs

Power. Power costs for the period January 8, 1974 through December 7, 1974 totaled $28,164.15 for 64,590 tons of waste processed or a cost of $0.44 per ton of refuse shredded. The total average electrical cost was $2,560.36 per month. The cost of electricity per shredder operational hour was $16.81.

Landfilling. During 1974, a total of 69,129 tons of shredded refuse and 62,314 tons of unshredded refuse was disposed of at the Onondaga County Solid Waste Disposal Authority's Brighton Heights Sanitary Landfill. This total of 131,443 tons of refuse was landfilled at an average cost of $2.67 per ton.

Shredder Facility Costs. These costs are for the full year 1974 and are based on shredding 69,129 tons of refuse. The costs are broken down into shredding costs, service center costs and transfer costs. All costs are included.

The shredding cost was $455,019 or $6.58 per ton. The service center cost was $33,599 or $0.49 per ton. The transfer cost was $59,295 or $0.86 per ton. The total shredder facility cost in 1974 was $547,913 or $7.93 per ton.

The year 1974 was the first year of operation of this facility. Production rates increased as the Authority's personnel became more experienced with the operation of the facility. The average tonnage shredded per operating day in 1974 was 284.5 tons. The Authority now feels that it can average at least 325 tons per operating day throughout the year.

It is estimated that the total cost per ton of $7.93 could be reduced to $6.94 with the projected increase in production and ignoring the effects of inflation. This is based on an average production of 325 tons of refuse shredded per operating day. This production rate appears to be conservative as production rates to date in 1975 have exceeded this amount.

SUMMARY

The hardware package, which consists of the Eidal Model SW-1150 shredder, the infeed conveyor, outfeed conveyor, transfer conveyor, and associated equipment, was inspected and checked between October 15 and 26, 1973, by a representative of the Eidal International Corporation with the assistance of Onondaga County Solid Waste Disposal Authority personnel.

From October 26, 1973 to December 6, 1973, the Authority made further checks and tests and painted and modified equipment. During this period of time tare weights for the City of Syracuse refuse collection trucks were obtained.

The shredder shakedown period commenced on December 7, 1973. The production of December 7 and 10, 1973, was classified as "break-in days". No quantities were recorded. Full production with recording commenced on December 11, 1973. The shakedown period was considered complete as of the end of December 1973.

The adjoining Shredder Unit No. 2 became operational in December 1974. The first unit was then shut down on December 28, 1974 to await replacements for severely worn shredder wall liner plates.

The collection of daily data for this report began on January 2, 1974, and continued through December 28, 1974. The analysis of this data is contained in the body of this report.

EVALUATION OF SHREDDING FACILITIES
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY, NEW YORK

FINAL REPORT

SECTION A

PERFORMANCE AND DAILY OPERATIONAL DATA FOR THE SHREDDER FACILITY

FACILITY THROUGHPUT

During the twelve month period of evaluation, which was also the first year of operation of the plant, the production rates increased greatly.

The operational production rate is defined as the number of tons of solid waste processed per unit of time during the time the shredder is actually grinding refuse. Downtime is omitted from this figure; therefore, it is a measure of the shredder's efficiency.[10] The operational production rate increased from 35.6 tons per hour to a high of 64.6 tons per hour in November 1974, with an average of 47.8 tons per hour for the year. The Eidal Shredder is rated conservatively at 40 tons per hour.

The overall production rate is defined as the number of tons of solid waste processed divided by the time the shredder was running plus downtime; therefore, it is a measure of the plant's efficiency.[10] The overall production rate increased from a low of 26.9 tons per hour to a high of 55.1 tons per hour in the month of November 1974, with an average of 38.0 tons per hour for the year.

A summary of the facility throughput for the study year 1974 is shown in Table 1. Daily quantities are included in the Appendix.

Table 1 shows that very high production rates were achieved in the last six months of the year. This is also the period of high moisture content as noted under MOISTURE CONTENT OF SHREDDED MATERIAL. In order to more accurately present production data, Table 2 was prepared using dry tons shredded and calculating production rates in dry tons per hour.

A comparison of dry tons per hour shows that the production rates for the last six months of the year are still higher than the first six months. However, the increase is not quite so dramatic. The table does show that

TABLE 1

FACILITY THROUGHPUT SUMMARY (WET BASIS)

Month 1974	Oper. Days	Total Tons Processed	Tons Processed Per Day	Production Rates Tons Per Hour Operational	Overall
January	22	4,649	211.3	35.8	26.9
February	20	5,092	254.6	37.4	30.7
March	11	2,969	269.9	35.6	31.2
April	22	6,065	275.7	39.2	31.7
May	22	5,224	237.4	39.6	28.1
June	20	4,576	228.8	42.6	31.5
July	23	6,572	285.8	50.2	38.8
August	19	6,169	324.7	53.5	43.4
September	21	7,393	352.1	61.4	48.5
October	23	7,771	337.9	59.8	50.3
November	21	7,212	343.4	64.6	55.1
December	19	5,437	286.1	57.2	47.3
Overall	243	69,129	284.5	47.8	38.0

TABLE 2

FACILITY THROUGHPUT SUMMARY (DRY BASIS)

Month 1974	Average Percent Moisture Content*	Dry Tons Processed	Production Rates Dry Tons Per Hour Operational	Overall
January	19.3	3,752	28.8	21.7
February	20.3	4,058	29.9	24.5
March	14.8	2,530	30.3	26.5
April	16.9	5,040	32.5	26.3
May	20.8	4,137	31.2	22.2
June	22.5	3,546	33.0	24.4
July	25.8	4,877	37.1	28.8
August	23.3	4,732	40.8	33.3
September	30.3	5,153	42.7	33.8
October	30.2	5,424	42.3	35.1
November	35.2	4,673	41.9	35.7
December	30.6	3,773	39.9	32.8
Overall	24.6	51,695	35.7	28.4

*Average moisture content of processed refuse.

for the last six months of the year, despite varying moisture contents of 23.3 per cent to 35.2 per cent, the production rates remained fairly constant.

The Authority in its first year of operation has found that production is directly related to materials handling. The rated capacity of the Eidal Shredder can be increased by keeping a constant, controlled flow of solid wastes into the shredder and providing enough transfer trucks to remove the shredded waste as fast as it is processed. Three 40 cubic yard transfer trucks are needed to haul the shredded solid wastes to the sanitary landfill.

In order to increase input the Authority also raised the restrictor bars. These restrictor bars are placed across the lower end of the infeed conveyor just beyond the point where the push pits load the infeed conveyor to control the burden height of solid waste on the infeed conveyor.

The above actions as well as an overall increase in efficiency as the Authority's personnel become experienced in the operation of the plant are the major reasons for the increased production at this plant.

During the year 1974 the shredder plant was in operation an average of 7.5 hours per day, with an average downtime or delays of 1.5 hours per day resulting in an average of 6.0 hours per day of actual production time.

POWER REQUIREMENTS

Introduction

The power consumption study for Shredder I Facility covers the period from January 8, 1974 to December 7, 1974. Data collected for December 1974 has been eliminated since Shredder II was put on line in this time period and both demand and kilowatt-hour usage value are much higher than average.

Our study is based on utility billing dates, the total number of hours during the billing period and the hours which the Shredder worked during the utility billing period.

The following are some definitions of terms used herein:

Kilowatt - Actual energy consumed in performing work

Kilowatt-hour - Measuring datum for energy usage

Demand - Maximum kilowatts consumed in any fifteen minute period

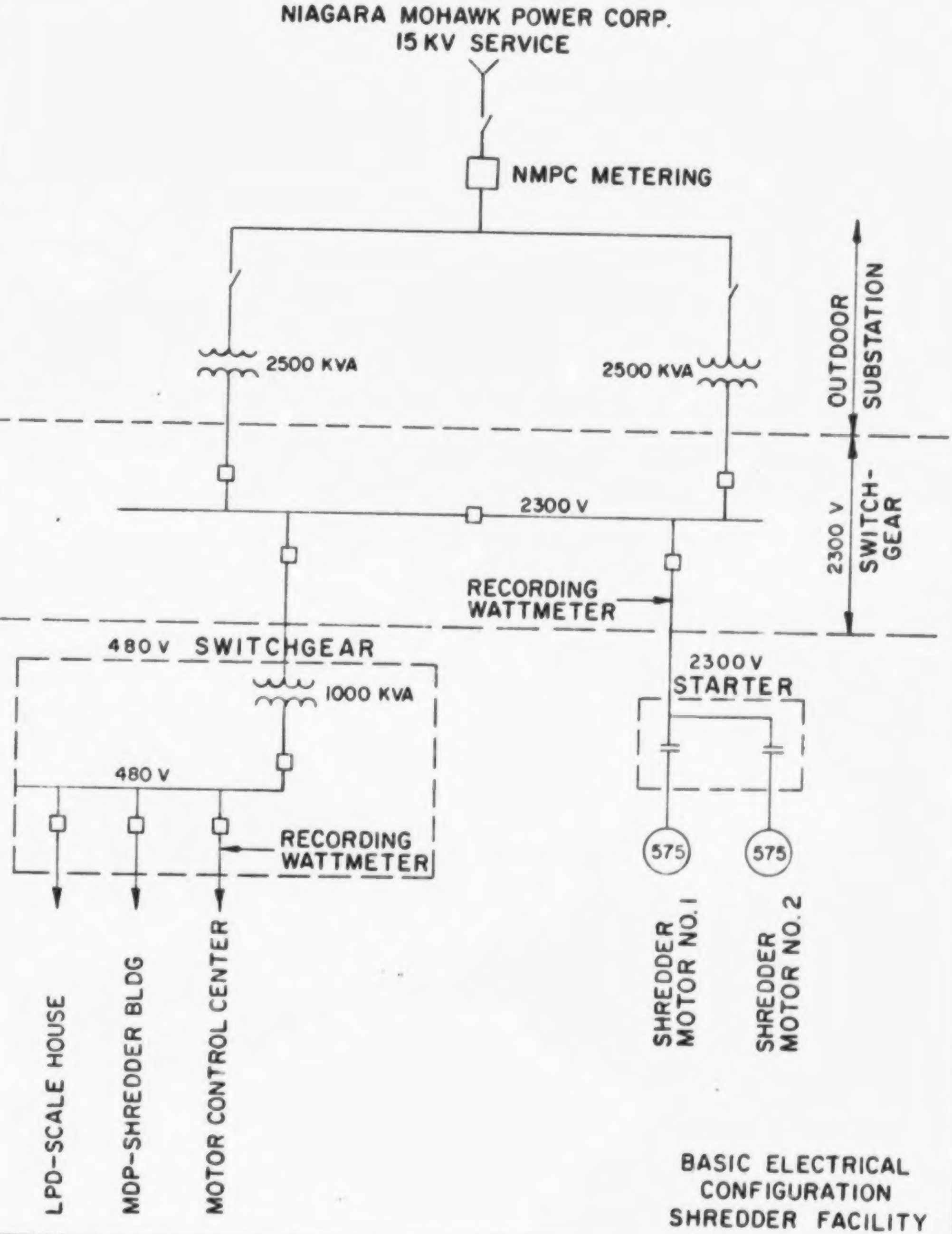
Reactive KVA Demand - KVA is made up of kilowatt and reactive KVA and is measured in kilovolt amperes. Reactive KVA is electricity which is used to keep the motors idling but not performing work. The utility fines the user for reactive KVA which exceeds a stipulated limit.

Total Hours - All hours in billing period

Operational Hours - Those hours during which the Shredder is operating.

Power System

The Shredder power system operates at 2300V while the conveyors and auxiliary equipment operate at 480V. Lighting and heat operates at 277V and 120V. Figure 10 is a single line diagram which shows the basic electrical configuration of the facility.



BASIC ELECTRICAL
CONFIGURATION
SHREDDER FACILITY

FIGURE 10

As can be seen from Figure 6, power consumption can easily be divided into four (4) groups:

a) Shredder

b) Motor Control Center (conveyors, packers, push pits)

c) Shredder Building Auxiliaries (light and heat)

d) Scale House (light and heat)

The average kilowatt-hour used by each segment can be estimated from field measured data. The breakdown of energy consumption during operational hours is as follows:

Shredder	256 KW/Hr
Motor Control Center	75 KW/Hr
Shredder Building	36 KW/Hr
Scale House	23 KW/Hr
	390 KW/Hr

During non-operational hours while repairs are being made to the Shredder and some Scale House load remains on line, the total load is 59 KW. When there is no work in progress, the load drops to 49 KW.

Power Consumption

Power consumption is shown in Table 3.

TABLE 3

POWER CONSUMPTION

(January 8 through December 7, 1974)

Billing Period Ending	Total Hours in Billing Period	Operational Hours	KW Demand	RKVA	KWH
2/74	696	173.3	651	462	100,800
3/74	720	150.8	525	441	88,200
4/74	696	130.8	672	504	86,100
5/74	768	177.4	609	546	96,600
6/74	720	177.6	756	567	79,800
7/74	768	133.9	483	525	65,100
8/74	744	144.6	588	546	69,300
9/74	672	142.8	588	567	79,800
10/74	696	155.1	567	546	86,100
11/74	768	148.2	546	525	86,100
12/74	768	140.9	546	735	105,000
1/74	Data Not Applicable				
Total	8016	1,675.4	6531	5,964	942,900
Average	728.7	152.3	594	542	85,718

AVERAGE SHREDDER DISCHARGE PARTICLE SIZE

The study included analyzing the particle size of the shredded refuse produced by the Eidal Shredder. Samples of the shredded waste were taken once a week from the transfer conveyor. These samples were spread out in a very thin layer and then air dried for a period of approximately seven days.

The air dried sample was then reduced to the proper size by quartering, the sample usually being quartered at least three times to get the desired sample size. Care was taken during the quartering process to insure that the extremely fine particles and the large pieces were evenly distributed throughout the sample during the quartering process.

A sieve analysis was then made of the quartered sample. In order to prevent larger pieces of waste material, generally paper products, from blocking screens and preventing the smaller particles from passing through the screens, it was found necessary to do some hand sorting of material and to pass the finer particles through the screens in the shaker first.

Results of the sieve analyses were plotted on semi-logarithmic paper. A graph showing the average shredder discharge particle size for each set of ring grinders used is included herein (Figure 11). Additional particle size graphs are included in the Appendix. Graphs were plotted for each month, January 1974 through December 1974. Graphs were also plotted for the periods January through February 1974, March through July 1974, and August through December 1974. January through February 1974 is the period of time when the original ring type grinders were in use in the shredder. These sixty original ring type grinders were replaced with new ones in early March 1974 and these remained in service until August 2, 1974. This second set of ring type grinders was replaced at that time and the third set remained in

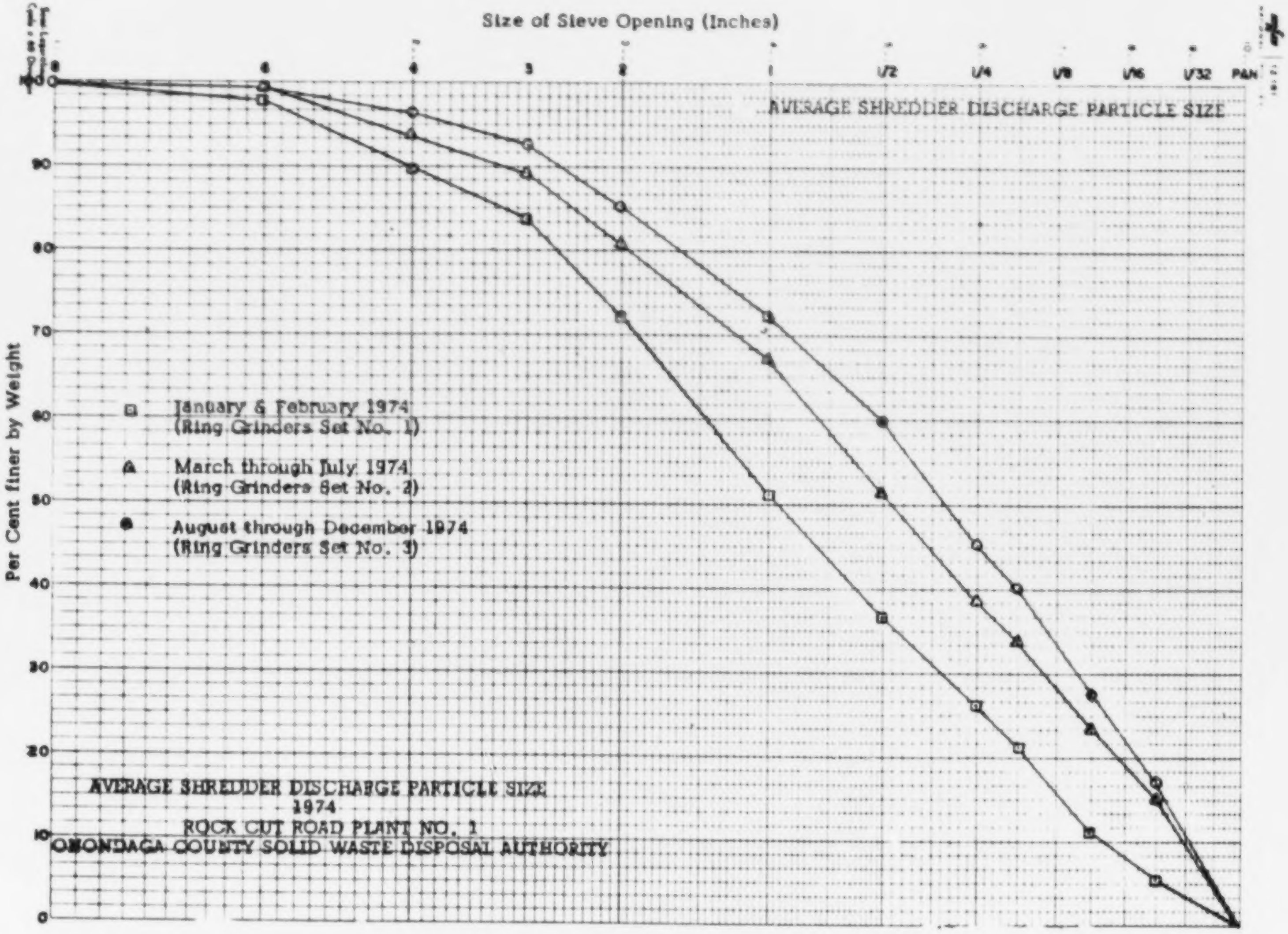


Figure 11. Average shredder discharge particle size January to December 1974.

service through the end of the study period.

The original set of ring type grinders processed 12,445 tons of refuse. This total includes 2,421 tons of refuse processed in December 1973 during the shakedown period. The second set of ring type grinders (March through July 1974) processed 25,854 tons of refuse. The third set of ring type grinders processed 33,251 tons of refuse. Experience indicates that the original set of ring type grinders was probably replaced prematurely.

An arbitrary fineness modulus was established for shredded refuse. Fineness modulus is a term often used as an index to the fineness or coarseness of aggregate. The lower the fineness modulus, the finer the particle size. It is not an indication of grading, for an infinite number of gradings can give the same value for fineness modulus.

The fineness modulus for shredded refuse was computed by adding the cumulative percentages retained on the standard screens, 4 inch, 2 inch, 1 inch, 1/2 inch, 1/4 inch, No. 8 and No. 16, and dividing the sum by 100.

Table 4 shows the shredded refuse fineness modulus.

A study of the Average Shredder Discharge Particle Size Graphs and the computed fineness modulus indicates that the replacement ring type grinders did a better job of reducing the particle size of the shredded waste than the original equipment grinders. In general the average discharge particular size gradually got larger as time progressed and as wear on the ring type grinders increased. In June and July 1974 and again in late November 1974 and in December 1974 it was observed that paper was being balled up or torn into long strips rather than being shredded into pieces, indicating the ring type grinders were badly worn.

TABLE 4

SHREDDED REFUSE FINENESS MODULUS

Month 1974	Fineness Modulus	Average Moisture Content	Ring Type Grinders	Tons of Refuse Processed
January	4.34	19.3	Set No. 1 (Original)	*12,445
February	3.74	20.3		
March	3.03	14.8	Set No. 2 (1st Replacement)	25,854
April	3.18	16.9		
May	3.33	20.8		
June	2.51	22.5		
July	3.78	25.8		
August	3.75	23.3	Set No. 3 (2nd Replacement)	33,251
September	3.45	30.3		
October	2.30	30.2		
November	2.65	35.2		
December	2.85	30.6		

*Includes 2,421 tons in December 1973

In November 1974, despite the fact that the ring type grinders were well worn, a comparatively low fineness modulus of 2.65 was obtained. The average moisture content during this month was 35.2%. This was the highest average moisture content for the year. A preliminary conclusion can be drawn to the effect that increased moisture content of the refuse results in a finer shredded product while increasing wear on the ring type grinders results in a coarser shredded product. Fineness of the shredded product also varies with the composition of the refuse, however.

The Authority feels that the present particle size is acceptable for their use in the landfill. Blowing paper is not a problem. A finer size requirement would probably cause more wear on the shredder and would also result in lower production rates.

Actual particle size requirements for shredded refuse would be determined by the final use of the shredded material, i. e. resource recovery, heat recovery incineration, etc.

FACILITY NOISE LEVELS

During surveys the following noise levels were noted and it appeared that they would be in existence for the majority of the normal working day.

	Date of Survey	
	1/15/74	4/9/74
Garage area adjacent to overhead doors	86 decibels	85-86 decibels
Caged maintenance area in garage	77 decibels	77 decibels
Below stairwell over input conveyor	102 decibels	101 decibels
Outside the operators booth	102 decibels	102 decibels
Inside the operators booth	82 decibels	81 decibels
On the catwalk by the shredder	102 decibels	106 decibels
On the catwalk by the compactor	102 decibels	103 decibels
Dumping pit area inside	80 decibels	90 decibels
Dump floor by the rear of the front end loader	86 decibels	Not taken

Noise levels at several locations in the plant exceed limits currently considered by the federal government as indicating danger of hearing loss through prolonged exposure.

Prolonged exposure to sound levels above 90 dB causes damage to the ear. This is the basis of the OSHA noise regulation limiting exposure times, shown on the following page.[6]

The Onondaga County Solid Waste Disposal Authority has purchased ear protective headgear for all employees and rotates employees in those areas where the noise is excessive.

OSHA Section 1926.52

Sound Pressure Level	Allowable Exposure Time
90 dB	8 Hours
92 dB	6 Hours
95 dB	4 Hours
97 dB	3 Hours
100 dB	2 Hours
102 dB	1½ Hours
105 dB	1 Hour
110 dB	½ Hour
115 dB	¼ Hour

ACTUAL OPERATING SPEEDS

Operating speeds of equipment are as follows:

1. Infeed Conveyor: 33.4 feet per minute.

   Operation of this conveyor is not continuous at this speed.

   Occasional stops are required.

2. Output Conveyor: 142.0 feet per minute.

   Continuous operation.

3. Transverse Conveyors: 170.0 feet per minute.

   Continuous operation.

4. Shredder Rotor Speed: 369 R.P.M.

   Continuous at this speed. Rotor reaches full speed in a few minutes after starting.

5. Packers

   Outward stroke 27.2 feet per minute.

   Inward stroke 57.3 feet per minute.

6. Push Pit Heads

   Outward stroke (loaded) 13.9 feet per minute.

   Inward stroke 20.7 feet per minute.

WEAR RATES

Wear rates have been found to be non-uniform. In the shredder the area under the top breaker arms, the bottom sweeper plates and the sweeper area at the bottom of the shredder are built up to proper dimension each day by welding. The top breaker bars are checked every day. The top breaker bars originally had to be built up by welding each day but experience and improved reinforcement techniques have stretched this period to three to five days. This technique consists of welding three No. 8 (one inch round) standard reinforcing bars around three sides (top, bottom, outside end) of the face of the breaker bars, and hardfacing between the reinforcing bars. This seems to protect the edges of the hard facing material.

When the top breaker bars need repair they are removed from the shredder at the end of the production day and are replaced with another set of breaker bars that was built up in the shop during the normal work day. The other areas of the shredder that require welding are built up in place at the end of the production day or on the third shift (two men welding).

Excessive wear had been experienced in the sweeper area of the shredder liner at the bottom of the shredder prior to the time when this area was built up by welding. This portion of the shredder wall which was originally about $1\frac{1}{2}$ inches thick was not lined with heat treated liner plates as the remaining walls of the shredder are.

On February 14, 1974, a hole was drilled through the plate and the thickness of the metal remaining was found to be 3/4 inches indicating 50 per cent wear in this area in a period of ten weeks operation. By visual inspection, there appeared to be areas that would be slightly thinner than the 3/4 inch, perhaps 5/8 inch, indicating a wear of 7/8 inch (58 per cent).

It was decided that liner plates similar to the heat treated liner plates in the shell of the shredder should be installed in the sweeper area in this lower portion of the shredder. As a temporary solution, a portion of the more seriously worn areas were built up by welding. Additional build-up by welding was required every day, and was very difficult to do because of limited access and limited working room.

Despite the continual build-up by welding a small hole appeared in the wall of the sweeper area of the shredder on May 6, 1974. On May 6 and 7, 3/4 inch thick steel plates were welded on the outside of the shredder in the sweeper area to reinforce these walls. This was a temporary solution until the new liner plates arrived.

One inch thick liner plates, made of "4140 Modified Steel", were installed in this bottom sweeper area on May 25, 1974. It was necessary to cut off the ends of the bottom sweeper plates to provide clearance. These plates were replaced on June 22, 1974, with one inch thick liner plates of "Gladiator Steel". The wear on the first set of liner plates varied from virtually nothing in some areas to as much as 5/8 inch indicating a maximum wear of 62 per cent. The liner plates of "Gladiator Steel" were changed approximately every five to six weeks throughout the rest of the year.

It is our opinion that the excessive wear in the bottom of the machine is caused by glass which breaks up into very fine particles and is not swept out as rapidly as other materials.

It was found that the shell wall in the upper portion of the shredder under the infeed conveyor was also showing signs of some wear. There are no liner plates in this area. Starting on April 20, 1974, this area was periodically built up by welding. By September 1974 considerable wear was observed in the main shell liner plates as well. These liner plates were finally replaced in February 1975. However, if new replacement liner plates had been available they would have been installed earlier, probably in November 1974.

There was also considerable wear on the 60 ring type grinders in the shredder rotor. These ring type grinders are similar in appearance to gears. The inside diameter is 5 inches, the outside diameter, out to out of teeth is 12 17/32 inches and the twelve teeth are approximately 1 15/16 inches long. In many cases the teeth were completely worn down and the wear continued into the body of the ring. Because of this wear the shredder was shut down between March 4 and 18, 1974, and the grinders were replaced. This was a scheduled maintenance which was planned to coincide with a required shutdown due to construction of the adjacent Solid Waste Milling Facility No. 2.

Fifty of the sixty ring type grinders were replaced and the teeth of the other ten were rebuilt and hard faced by welding. The ten rebuilt grinders were placed in the top of the rotor. Some of the weld on these rebuilt grinders chipped off soon after.

Extreme wear was noted on the 60 ring type grinders in July 1974. These were removed and replaced between August 3 and 6, 1974. Work was started on a weekend, so only two production days were lost. (Extreme wear was noted on the replacement set of ring type grinders. These were removed and replaced on May 5, 1975).

Measurements were taken of the worn grinders. Minimum and maximum amounts of wear on each grinder are shown in tables 28, 29 and 30 in the Appendix. The grinders that were the more severely worn were those located at the bottom of the shredder.

The Authority has found that it is imperative that areas subject to wear be constantly inspected in order to catch wear before it becomes a problem.

PREDICTED LIFE OF EQUIPMENT

The following is the estimated life of equipment:

1.	Major Equipment (Shredder and Conveyors)	15 years*
2.	Electric Substation	50 years
3.	Electric Switchgear	50 years
4.	Packers	15 years
5.	Push Pit Shields	15 years
6.	Major Motors and Starters	30 years
7.	Truck Lift	15 years
8.	Overhead Crane	15 years

*With constant maintenance.

RECURRING PROBLEM AREAS

The material delivered to the shredder can generally be classified in the following categories: (1) normal domestic waste including garbage, rubbish, and household bulk wastes such as chairs, tables, cabinets, stuffed chairs, sofas, hide-a-beds, innerspring mattresses, bed frames, bed springs, rolled carpets, small tree limbs (up to $1\frac{1}{2}$ inches), foliage, fences, flooring, siding, doors, lumber, storm windows, screen doors, plumbing fixtures and automobile tires with or without steel wheels; (2) commercial and industrial wastes including garbage, rubbish, brush, pallets and packaging materials; (3) metals, i.e. gears, axles, disc brake drums, fly wheels, drive shafts and crank shafts; (4) refrigerators, stoves, washers, dryers and hot water tanks; (5) loads requiring hand unloading; (6) cardboard; and (7) Christmas trees (seasonal).

General

The normal domestic wastes and the commercial and industrial wastes generally have not caused any difficulties, proceeding through the dumping, conveying-in, shredding, conveying-out, and loading-out sequence quite easily. Gears, axles, disc brake drums, fly wheels, drive shafts, crank shafts, and large hot water tanks will jam the shredder, and must be removed from the infeed conveyor prior to reaching the shredder. This requires that the infeed conveyor be stopped. These articles are stored out back and periodically sold for scrap (Figure 12).

At the beginning of the year, it was found that refrigerators, stoves, washers and dryers could be used to clean out the shredder and to keep the ring type grinders from binding. When these articles are observed on the infeed conveyor, the conveyor is stopped, and they are picked off the conveyor by overhead crane and placed aside until the end of the shift. At

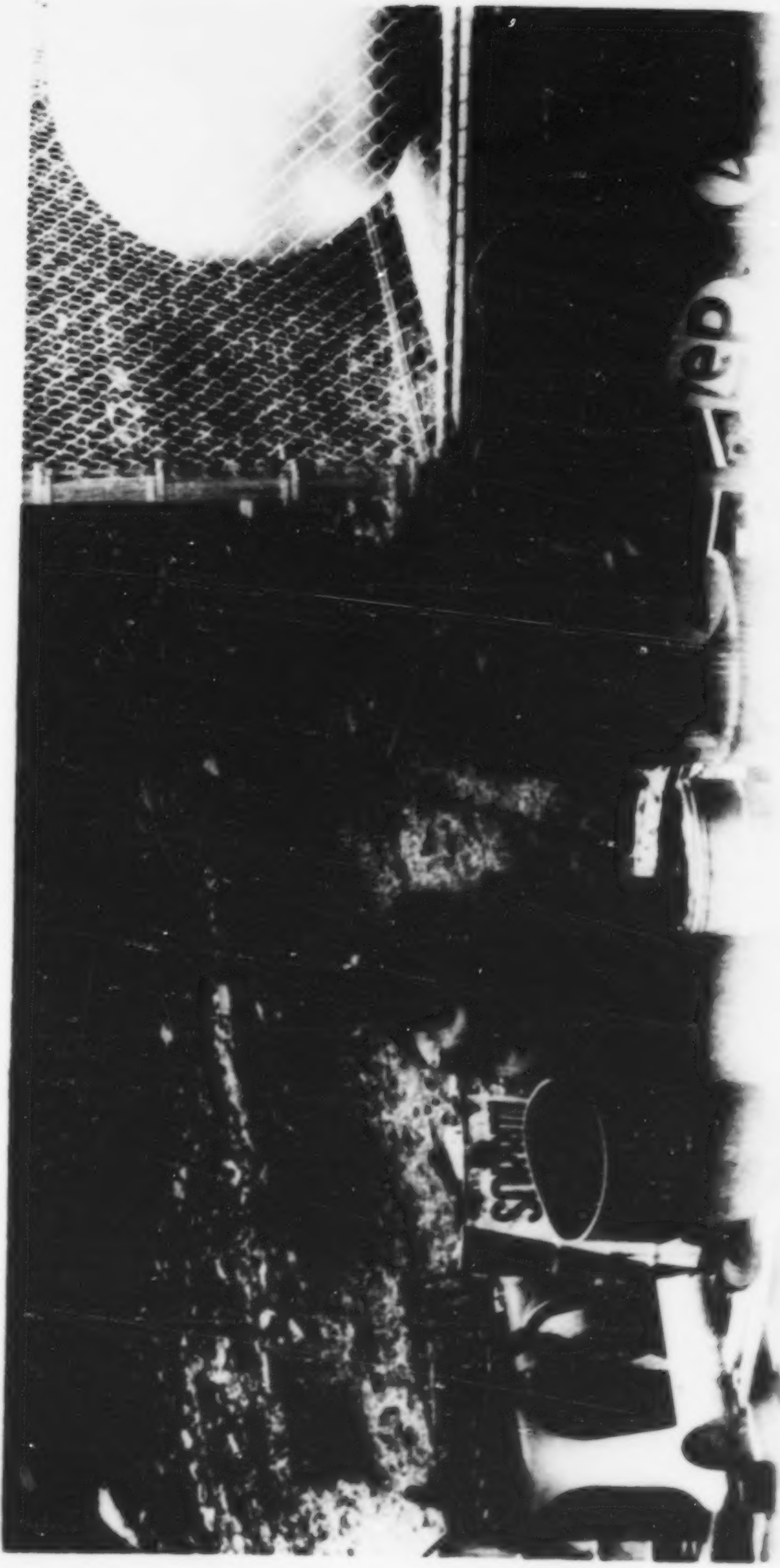


FIGURE 12. Items not shredded and sold as scrap.

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this time they are reset on the infeed conveyor and run through the shredder. This picking operation causes a short delay.

Loads of incoming materials that must be hand unloaded cause a delay in the dumping operation which occasionally requires other trucks to wait in line outside the shredder plant. These loads that must be hand unloaded are usually from private organizations that arrive in trucks that do not have automatic unloading or dumping features. The Authority attempts to schedule these loads in the afternoon when the plant is not so overloaded so that there will be less interference with its normally busy operations in the morning. The rescheduling has generally been successful.

The dump floor area (tipping floor) is approximately 93 feet wide by 33 feet deep. During busy times, especially in the morning, the shredder can not process the refuse as fast as it is received. The refuse is then temporarily stored on the dump floor, occasionally spilling outside the building.

Based on their experience here, Authority's personnel feel that the dump floor area could be larger. This would keep the refuse under cover at all times, would allow more room for hand unloading and would provide more room for any sorting and mixing operations found necessary.

Jams

Jams are the prime cause of delays. In addition to internal jams in the shredder, there are external jams in the conveyor system, both infeed and outfeed. These can be further classified as bridges, restrictor bar jams, hood jams, discharge jams and transfer jams.

A bridge is a jam at the point where the push pits feed the infeed conveyor, and is caused when the push pits are overloaded and a large amount of refuse is pushed ahead of the shield. When the push shield reaches the infeed conveyor opening, the excess refuse, which towers above the push shield, falls across the opening and forms a bridge. This is usually cleared by removing the refuse with a rubber tired backhoe. This type of jam can be eliminated by not overloading the push pits.

The restrictor bar is a bar set across and above the infeed conveyor at the lower end of the conveyor near the opening to the push pits. This acts as a leveling bar to keep the refuse on the infeed conveyor at the optimum height for feeding to the shredder. Jams occur here when too much material is fed to the infeed conveyor at one time. Proper loading of the push pits helps to overcome this problem, also.

Hood jams are jams at the point where the infeed conveyor feeds the shredder. These are generally caused by too much material being fed to the shredder at one time or oversize material getting caught in the hood opening. Proper feed rates help to overcome this problem along with removal of oversize material from the infeed conveyor.

Internal jams in the shredder occur when materials such as large hot water tanks, gears, axles, crank shafts, long pieces of steel cable and large pieces of metal are fed to the shredder. These must be removed while on the dump floor or on the infeed conveyor. Failure to do so can not only jam the shredder and cause excessive wear, but also damage the shredder. On Friday, November 8, 1974, two pieces of metal approximately 8 inches by 8 inches by 4 inches and 8 inches by 8 inches by $2\frac{1}{2}$ inches got into the shredder. They cracked the plate underneath the breaker arms and one of the top liner plates. These were repaired by grinding out and welding the crack. A crack also occurred in the top of the shredder, just under the hood. The inside was repaired by grinding out and welding the crack, the outside by welding a 3/4 inch thick plate over the crack. Production was not affected by this damage as it occurred at the end of the day on a Friday, and repairs were completed over the weekend.

Large amounts of Christmas trees and cardboard have a tendency to jam the shredder. It is necessary that these items be fed through in small amounts. This requires some additional material handling and a slowdown of the infeed conveyor.

Discharge jams are the most prevalent of all. These occur at the point where the shredder discharges the shredded waste onto the outfeed conveyor. The prime reason for these jams appears to be that the shredder discharge opening is just too small.

In order to reduce jam ups in the discharge chute the Authority on June 5, 1974, cut down the size of the baffle plate at the end of the chute. This seems to have helped reduce jam ups at this location.

Transfer jams occur at the point where the output conveyor discharges to the transfer conveyor. These are generally caused when the outfeed conveyor is heavily loaded with cardboard and paper. The height of the opening at the top of the output conveyor was increased from 15 inches to 22 inches by shifting a motor mounting platform, and this appears to have eliminated jams at this location.

The Authority has found that the more the incoming waste is mixed, the better the flow through the whole shredding operation. Jams are more likely to occur when large amounts of cardboard or paper are processed alone than when mixed refuse is processed.

Fires and Explosions

There have been occasional fires and explosions in the shredder. These are caused by the ignition of paint thinners or other flammable liquids by sparks from the shredding action of metal in the refuse. Generally these fires and explosions have just caused short interruptions in operations.

One fire on May 16, 1974 caused a shutdown of 3.7 hours. This was caused by an explosion of pharmaceutical wastes which were batch fed. This fire was extinguished with water. No machine damage occurred and most of the shutdown time was devoted to clean-up after the fire.

An explosion and fire due to a large quantity of acetone on August 22, 1974 caused a shutdown of 1.0 hour. Debris was blown about. This fire was smothered by continued feeding of raw waste into the shredder. There was no damage to the shredder itself but the infeed hood over the shredder suffered some damage. A weld at the top of the infeed conveyor opening broke. This was repaired at once. The sides of the hood were spread out by the force of the explosion, and this was repaired on a weekend.

Care is taken to remove paint thinners, flammable paints, gasoline cans and propane tanks before they get into the shredder if they can be found in time.

Stationary Compactors

There have been occasional problems with the electrical relays on the stationary compactors. The relays are replaced as required. The teeth of the drive coupling wear off, and the coupling must be replaced approximately every three months.

Electrical

There have been occasional electrical problems in the operation.

Generally these have been minor, causing relatively short interruptions in service.

Shear Pins

Shear pins on the conveyors break at random intervals. When the feed conveyor jams due to a restrictor jam, it shears the pin. A stock of shear pins is kept on hand.

Oil Pressure

On August 28, 1974, the shredder built up excessive oil pressure and was shut down. It was found that the jets spraying oil onto the gears in the bottom well of the shredder had become plugged. The jets were cleaned. The shredder manufacturer had stated that these jets should be cleaned once a year but the Authority now cleans these jets monthly. This has eliminated this problem.

Miscellaneous

Low water pressure on June 21, 1974 was responsible for an interruption in service on this day.

OPERATING HOURS, DOWNTIME AND PRODUCTION TIME

Records were kept by the Onondaga County Solid Waste Disposal Authority on the daily operating hours of the facility, breakdown time and actual production time, with an explanation of downtime. Copies of these records for the study year 1974 are contained in the Appendix. A monthly production chart summary is shown in Table 5.

TABLE 5

MONTHLY PRODUCTION CHART SUMMARY

Month 1974	Total Spin Time (Hrs)	Break Down Time (Hrs)	Materials Flow Interruption Time (Hrs)	Production Time (Hrs)	
Jan.	172.8	7.0	35.4	130.4	
Feb.	165.6	1.3	28.7	135.6	
Mar.	95.3	0	11.8	83.5	Plant shut down for major maintenance March 4 thru 18, 1974
Apr.	191.4	0	36.1	155.3	
May	186.2	19.2	34.6	132.4	
June	145.4	23.4	14.7	107.3	
July	169.5	7.9	30.1	131.5	
Aug.	142.1	9.1	17.1	115.9	Plant shut down for major maintenance August 5 thru 7, 1974
Sept.	152.4	8.5	23.1	120.8	
Oct.	154.6	11.2	15.2	128.2	
Nov.	130.8	4.6	14.6	111.6	
Dec.	114.9	2.6	17.8	94.5	
Total	1821.0	94.8	279.2	1447.0	
Average Per Day	7.5	0.4	1.1	6.0	

Production Chart Definitions

Total Spin Time. The time between the initial start-up of the shredder to the shut down at the completion of the production day. On days that the shredder did not operate due to breakdowns the spin time was arbitrarily set at 8.0 hours. Thus the breakdown time for those days was also 8.0 hours.

Downtime. Time in which the shredder is not grinding refuse between the initial start-up of the shredder to the shut down at completion of the production day (e.g.) any time the shredder is not processing refuse during normal working hours.

Breakdown Time. Downtime attributed to a breakdown in equipment.

Materials Flow Interruption Time. Downtime not attributed to equipment breakdowns. This is generally downtime caused by jam up of refuse, waiting for garbage after initial start-up of the shredder, waiting for transfer trucks, stopping the infeed conveyor to remove articles that are not to be processed (i.e. gears, axles and large hot water tanks) and other minor operational problems.

Materials flow interruption time is 75 per cent of the total downtime or non-production time.

Production Time. Time in which the shredder is actually grinding refuse.

MAINTENANCE

In order to keep the refuse production rates high it is necessary that shredder shutdown be minimized. Preventative maintenance must be scheduled and religiously performed as required.

Daily Routine Maintenance

Shredder. The area under the top breaker bars and the bottom sweeper plates are hardfaced every day. The replaceable top breaker bars are hardfaced every three to five days. The top and bottom bearings and the clutch are greased daily. The oil is checked daily.

Conveyors and Packers. All fittings of the conveyors and stationary compactors are greased daily.

Cleanup. The dump floor, push and conveyor pits, shredder room, stationary compactors and conveyors are cleaned daily.

Weekly or Bi-Weekly Routine Maintenance

Shredder. The separator plates are hardfaced, any bound up ring type grinders are freed, any rotor damage is repaired, and any required welding on the shredder or liners is done.

Conveyors. Pins in the drive chains are sprayed with liquid "Never Seze" once a week. Original practice had been to do this once a month. This was changed to once a week after the pins in the drive chain of the outfeed conveyor seized up on September 11, 1974.

Periodic Routine Maintenance

Shredder. The ring type grinders are removed and replaced as required. It has been found that one set of ring type grinders can process approximately 25,000 to 30,000 tons of refuse. As indicated previously, attempts were made to hardface the tips of the teeth of the grinders but this proved unsuccessful.

The sweeper area liner plates are replaced every five to six weeks (8,000 to 9,000 tons). The shredder was not originally furnished with sweeper area liner plates; extensive wear in this area required constant hardfacing.

The liner plates in the upper area of the shredder are built up and hardfaced as required. Over 71,000 tons of refuse were processed with the original liner plates in place. It would appear that the shredder wall liner plates should be replaced every 60,000 to 70,000 tons.

The bottom sweeper plates, which sweep the shredded refuse out of the shredder, are replaced every four months.

Shredder Hood. The hood on top of the shredder into which the refuse is fed sustains considerable abuse. Repairs are performed on the hood whenever required.

Shredder Gear Box. The jets spraying oil on the gears in the bottom well of the shredder which have a tendency to plug up, are cleaned monthly, thus eliminating the problem.

Electrical Switch Gear Equipment. The supplier of the electrical switchgear comes to the site every six months to clean, check out and adjust this equipment. This work is scheduled on a weekend.

Non-Routine Maintenance

Repair of breakdowns in the equipment is called non-routine maintenance. Breakdowns are listed in the Daily Production Chart in the Appendix.

Hardfacing

Hardfacing of wear areas on the shredder is a continuous maintenance item. Haynes 5/32, 3/16 or 1/4 inch Ni-Mang rod is used to build up worn areas. A Haynes 5/32 or 1/4 inch H-52 (5261) rod is used for the last two passes.

WATER USED FOR SHREDDER OPERATION

In January 1974 the shredding operation used an average of 2.0 gallons per minute during actual production time. In the first twelve days of February 1974 the operation used an average of 1.4 gallons per minute during actual production time.

On February 13, 1974, the Authority discontinued adding water to the refuse in the shredder as they found that the wetter the refuse the more likely it would be for the ring type grinders to seize up. Therefore, after this date the water used for the shredder's operation was virtually nil.

MOISTURE CONTENT OF SHREDDED MATERIAL

Moisture content of the shredded refuse was determined throughout the study period. The moisture content is the ratio of the weight of water in a given mass of shredded material to the net wet weight of the given mass of the shredded material and expressed as a percentage.

Table 6 shows the moisture contents of the shredded refuse throughout the study year 1974.

TABLE 6

MOISTURE CONTENT

Month 1974	Range Per Cent	Average Per Cent
January	16.7 to 21.3	19.3
February	13.3 to 29.0	20.3
March	10.0 to 19.7	14.8
April	14.5 to 19.4	16.9
May	11.7 to 29.5	20.8
June	17.8 to 26.3	22.5
July	18.6 to 37.8	25.8
August	17.4 to 30.1	23.3
September	22.9 to 38.7	30.3
October	24.3 to 38.8	30.2
November	32.6 to 41.1	35.2
December	20.7 to 35.0	30.6
Summary for Year 1974	10.0 to 41.1	24.6

The table shows considerable variation in moisture contents throughout the year. For the first six months of the year, moisture content ranged from 10.0 to 29.5 per cent, whereas, during the last six months it ranged from 17.4 to 41.1 per cent. High individual moisture contents throughout the year can generally be attributed to rainfall during the collection function. This was particularly true during the months of November and December when the highest monthly average moisture contents were obtained. The high moisture contents in the summer and fall can possibly be attributed to the increased amounts of yard wastes such as grass clippings and leaves in the shredded refuse.

When the Authority discontinued adding water to the refuse on February 13, 1974, this action did slightly decrease the moisture content. Refuse composition and weather conditions prevailing during collection appear to have more effect on moisture content, but moisture from these sources does not seem to make the ring type grinders seize up so much as water added at the shredder did.

DUST COLLECTING EQUIPMENT

The outfeed conveyor, the transfer conveyor and the tops of the hoppers over the packers are covered with $\frac{1}{2}$ inch mesh screening. The $\frac{1}{2}$ inch openings allow dust and small particles to pass through the screening and into the shredder room itself. Quite a bit of material is caught on the screening; however, these screens are cleaned daily. The use of a solid cover in place of screening would not permit observation of the conveyor operation.

FACILITY HOUSEKEEPING REQUIREMENTS

Cleanup is done at the end of each day's operations. Dust is removed from the dust collecting screens over the outfeed and transfer conveyors and packer hoppers. The packers and conveyors are cleaned. The dump floor, the push and conveyor pits and the shredder room are swept up. Occasional cleanup is required behind the push heads when material inadvertently falls behind them.

Dust is prevalent throughout the shredder facility. As noted under MOISTURE CONTENT OF SHREDDED MATERIAL, the discontinued practice of adding water to the garbage has undoubtedly contributed to the dust problem, and more cleanup time is thereby required.

EVALUATION OF SHREDDING FACILITIES
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY, NEW YORK

FINAL REPORT

SECTION B

COST DATA FOR DAILY OPERATION OF SHREDDER FACILITY

POWER COSTS

Table 7 is the tabulation of all utility bills for the study period. The cost of power varies due to the fluctuation in the fuel adjustment rate charged each month. The fuel adjustment rate varies up or down with the cost of fuel purchased by the Niagara Mohawk Power Corporation for power generation.

TABLE 7

POWER COSTS
(January 8 through December 7, 1974)

Billing Period Ending	KW Demand Cost	RKVA Cost	KWH Cost	Total Cost	Cost/ Ton*
2/74	$ 1,014.75	$ 66.31	$ 1,084.03	$ 2,165.09	$0.49
3/74	936.55	74.48	1,034.24	2,045.27	0.43
4/74	1,176.37	75.79	1,086.00	2,338.16	0.57
5/74	1,184.49	102.44	1,285.52	2,572.45	0.46
6/74	1,358.89	88.20	1,140.25	2,587.34	0.47
7/74	1,108.78	108.71	1,128.17	2,345.66	0.47
8/74	1,110.80	101.27	1,227.67	2,439.74	0.41
9/74	1,003.31	96.95	1,541.32	2,641.58	0.41
10/74	1,146.05	96.63	1,551.48	2,794.16	0.38
11/74	1,297.08	102.44	1,563.52	2,963.04	0.40
12/74	1,297.07	165.16	1,809.43	3,271.66	0.42
Total	$12.634.14	$1,078.38	$14.451.63	$28.164.15	$0.44
Average	$ 1,148.56	$ 98.03	$ 1,313.78	$ 2,560.37	

*Based on 64,590 tons milled

The data is tabulated to establish an average cost per month. The average operational hours per month of 152.3 hours is obtained from Table 3. With these averages, cost per hour is computed as shown on the following page.

Total Average Electrical Cost = the cost of KW Demand + RKVA Demand + KWH = $1,148.55 + $98.03 + $1,313.78 = $2,560.37

Cost of Electricity per Operational Hour =

$$\frac{\text{Total Cost}}{\text{Operational Hours}} = \frac{\$2,560.37}{152.3} = \$16.81/\text{Operational Hour}$$

As discussed earlier under POWER REQUIREMENTS, the breakdown of energy consumption during operational hours is as follows:

Shredder	256 KW/Hr
Motor Control Center	75 KW/Hr
Shredder Building	36 KW/Hr
Scale House	23 KW/Hr
	390 KW/Hr

During non-operational hours, while repairs are being made to the Shredder and some Scale House load remains on line, the total load is 59 KW. When there is no work in progress, the load drops to 49 KW.

Table 8 shows the relationship of this load breakdown to total power costs. In Table 8 the Motor Control Center load is broken down to operating equipment and Shredder Building load is divided into operating and non-operating loads.

TABLE 8

POWER REQUIREMENTS AND COSTS FOR OPERATING SHREDDER AND CONVEYORS

	Hrs/Month (Average)	KW/Hr	KW/Month*	Cost/Month @ $0.015/KWH+
Shredder	152.3	256	38,988	$ 584.82
Motor Control Center	152.3	-	-	-
Push Pit	152.3	25	3,807	57.11
Infeed Conveyor	152.3	12	1,827	27.41
Discharge Conveyor	152.3	5	761	11.42
Transfer Conveyor	152.3	3	456	6.84
Packer	152.3	30	4,569	68.54
Shredder Building (Operating)	152.3	36	5,482	82.24
Shredder Building (Non-Operating)	576.4	26	14,986	224.79
Scale House (Operating and non-operating)	728.7	23	16,760	251.40
Sub Total				$1,314.57

Charges attributable to Shredder Only:

Reactive KVA Demand Cost	$ 98.03	
Average KW Demand Cost	1,148.55	
	$ 1,246.58	$1,246.58
Total Average Monthly Power Cost for Facility		$2,561.15
Total Monthly Power Cost to Run Shredder Only		$1,831.40

*KW/Hr x Operational Hour/Month

+0.015/KWH = $\frac{\text{KWHCost from Table 7}}{\text{KWH from Table 3}}$

LANDFILLING

The Onondaga County Solid Waste Disposal Authority landfills both shredded and unshredded refuse at its Brighton Heights Sanitary Landfill. During 1974, 69,129 tons of shredded refuse and 62,314 tons of unshredded refuse were landfilled at this site. This is a total of 131,443 tons of refuse and averages 506 tons per day.

The total cost of landfilling at this site in 1974 was $351,022 with a

TABLE 9

LANDFILL COSTS - 1974

Cost Item	Total Cost	Cost/Ton*
Labor+	$ 83,134	$ .63
Rental		
Land‡	3,600	.03
Equipment	105,424	.80
Other	675	.01
Cover Material	107,948	.82
Roadway Maintenance	9,943	.08
Contracted Services		
Equipment Maintenance	1,815	.01
Security	30,459	.23
Pest Control	975	.01
Other	486	-
Utilities		
Electric	598	.01
Water	26	-
Supplies		
Lubricants	1,962	.01
Repairs & Maintenance	3,606	.03
Other	337	-
Miscellaneous	34	-
Total	$351,022	$2.67

*Based on 131,443 tons landfilled, 69,129 tons of shredded refuse and 62,314 tons of unshredded refuse.

+Includes all fringe benefits except accrued vacation not used.

‡An additional 7 acres of land adjacent to Authority's Brighton Heights Sanitary Landfill was rented in 1974 for $300 per month.

cost per ton of $2.67. This includes all costs of the landfill including charges for land and final cover. Table 9 presents the actual costs for operating the Brighton Heights Sanitary Landfill during 1974.

The greatest costs of operating this landfill are the charges for cover material, equipment rental and labor, in that order. The cover material is purchased from a pit adjacent to the landfill. The cost of providing cover material is 30.8% of the total cost of the landfill. The advantage of having an on site source of cover material owned by the municipal entity operating the landfill is obvious.

SHREDDER FACILITY COSTS

Costs presented are for the full 1974 year, the first year of operation of the facility. Costs are broken down into shredding costs, service center costs and transfer costs. All costs are included.

Shredding Costs

The shredding cost in 1974 was $455,019. The cost per ton, based on shredding 69,129 tons of refuse, was $6.58. The total cost and cost per ton for each cost item is listed in Table 10.

TABLE 10

SHREDDING COSTS - 1974

Cost Item	Total Cost	Cost/Ton*
Labor+	$106,535	$1.54
Rental-Equipment	502	0.01
Contracted Services	4,216	0.06
Engineering Services	1,980	0.03
Utilities		
Electric	30,165‡	0.44
Water	125	-
Gas	11,375	0.16
Telephone	92	-
Supplies**	39,538	0.57
Shredder Parts		
Replacement Parts	22,822	0.33
Spare Parts on Hand	14,654	0.22
Maintenance Repairs	8,080	0.12
Rental-City of Syracuse	199,208	2.88
Amortization of Equipment	15,499	0.22
Other	28	-
Total	$455,019	$6.58

*Based on 69,129 tons of refuse shredded

+Includes all fringe benefits except accrued vacation not used.

‡Based on 12 months billing.

**Supplies itemized in next table.

The costs per ton are calculated by dividing the actual annual cost by the actual tonnage shredded.

The largest cost item is the rental cost of $199,208 charged by the City of Syracuse. The City of Syracuse financed the cost of the construction of the shredder plant. Under the Authority's contract with the City, the City will receive as credits to its charges for disposal the amount of interest and principal paid by the City for the reduction of its debt. For accounting purposes this is called rent. For 1974 the interest portion of the payment was $84,208 and the principal portion was $115,000. The life of the payments is 15 years. The total capital cost of the facility including engineering design, construction, and equipment is $1,849,309.25, including $128,133 paid by the federal government as part of the shredder equipment package.

The spare parts on hand listed under shredder parts is a one time charge listed for 1974 (Table 11). The Eidal International Corporation sold its shredder manufacturing business and the Authority was able to purchase a large number of spare parts at a substantial reduction in price. This will reduce the cost of parts in future years.

The year 1974 was the first year of operation of this facility. Production rates increased as the Authority's personnel became more experienced with the operation of the facility. The refuse shredded increased from an average of 211.3 tons per day in January 1974 to a high of 352.1 tons per day in September 1974, with an average for the year of 284.5 tons per day. The Authority feels that it can average at least 325 tons per operating day throughout the year.

Experience to date in 1975 shows this figure to be on the conservative side. It is estimated, ignoring the effects of inflation, that shredding costs might be reduced to approximately $5.76 per ton.

The supplies cost is broken down in Table 11.

TABLE 11

BREAKDOWN OF SHREDDING SUPPLIES COST

	Total Cost	Cost/Ton*
Lubricants	$ 3,302	$0.05
Repair & Maintenance (General)	13,216	0.19
Welding Supplies	6,238	0.09
Front End Loader Maintenance	5,831	0.09
Push Pit Maintenance	2,294	0.03
Push Pit Spare Parts	5,122	0.07
Shop	700	0.01
Diesel Fuel (Front End Loader)	1,463	0.02
Other	1,372	0.02
Total	$39,538	$0.57

*Based on 69,129 tons of refuse shredded

Service Center Costs

The service center is the maintenance shop. The service center costs are the costs of operating the service center and includes other costs not directly attributable to either the cost of shredding or transfer.

The service center total cost in 1974 was $33,599. Cost per ton based on 69,129 tons of refuse shredded was $0.49. These costs could be reduced to about $0.43 per ton with the projected increase in production, and ignoring the effects of inflation.

The total cost and cost per ton of each cost item is listed in Table 12.

Transfer Costs

The transfer cost in 1974 was $59,295. The cost per ton based on 69,129 tons of refuse shredded was $0.86. The total cost and cost per ton for each cost item is listed in Table 13.

TABLE 12

SERVICE CENTER COSTS - 1974

Cost Item	Total Costs	Cost/Ton*
Labor+	$10,297	$0.15
Equipment Rental	640	0.01
Contracted Services		
Maintenance	812	0.01
Pest Control	124	-
Uniforms	4,471	0.06
Other	2,014	0.03
Supplies		
Lubricants	3,112	0.05
Repair & Maintenance	812	0.01
Shop	3,549	0.05
Gasoline	595	0.01
Diesel Fuel	517	0.01
Small Tools	1,514	0.02
Other	565	0.01
Miscellaneous	5	-
Amortization	4,572	0.07
Total	$33,599	$0.49

*Based on 69,129 tons of refuse shredded.

+Includes all fringe benefits except accrued vacation not used.

TABLE 13

TRANSFER COSTS - 1974*

Cost Item	Total Cost	Cost/Ton+
Labor‡	$26,577	$0.38
Contracted Services	4,289	0.06
Supplies		
Lubricants	349	0.01
Repair & Maintenance	1,878	0.03
Diesel Fuel	4,550	0.07
Amortization§	21,652	0.31
Total	$59,295	$0.86

*Landfill disposal costs not included.

+Based on 69,129 tons of refuse shredded.

‡Includes all fringe benefits except accrued vacation not used.

§Total cost of 3 trucks $110,260. Vehicle amortized over 5 years with total salvage value of $6,000 ($2,000/truck). Balance is amortization of miscellaneous items over 2 years with no salvage value.

These costs can be reduced to about $0.75 per ton with the projected increase in production, and ignoring the effects of inflation.

Summary of Shredder Facility Costs

A summary of the shredder facility costs for 1974 is given in Table 14.

TABLE 14

SUMMARY OF SHREDDER FACILITY COSTS - 1974

Cost Item	Total Cost	Cost/Ton*
Shredding Costs	$455,019	$6.58
Service Center Costs	33,599	0.49
Transfer Costs	59,295	0.86
Total	$547,913	$7.93

*Based on 69,129 tons of refuse shredded.

The cost per ton of $7.93 could be reduced to $6.94 with the projected increase in production and ignoring the effects of inflation. This is based on an average production of 325 tons of refuse shredded per operating day. This production rate appears to be conservative as production rates to date in 1975 have exceeded this amount.

MANPOWER REQUIREMENTS

The manpower requirement for normal daily operation of the shredder facility was as follows:

1 Control Cab Operator

1 Front End Loader Operator

1 Dump Floor Man

1 Scale Operator

1 Laborer

The manpower requirement for transfer of shredded wastes to the landfill was as follows:

3 Packer Truck Drivers

The manpower requirement for routine maintenance was as follows:

1 Foreman

2 Welders (Third Shift Only)

2 Maintenance Mechanics

1 Trainee - Welder

Non-routine maintenance is generally done by the foreman and the two maintenance mechanics listed above.

The manpower requirement for the service center is as follows:

1 Trainee - Automotive Mechanic

1 Tool Crib Attendant

The breakdown of labor costs into the five categories described above is shown in Table 15 and is included within summary costs shown in Table 14.

The largest categories are routine maintenance at 12,627 manhours and shredder facility operation at 10,768 manhours.

TABLE 15

BREAKDOWN OF LABOR COSTS - 1974

	Man-Hours			Cost/
	Total	Per Week	Cost*	Ton+
Shredder Facility Operation	10,768	207.1	$ 43,939	$0.64
Transfer - Transport	6,967	134.0	26,577	0.38
Routine Maintenance	12,627	242.8	56,293	0.81
Non-Routine Maintenance	1,139	21.9	6,303	0.09
Service Center	3,653	70.2	10,297	0.15
Total	35,154	676.0	$143,409	$2.07

*Includes all fringe benefits except accrued vacation not used.
+Based on 69,129 tons of refuse shredded.

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APPENDIX A

NEW YORK STATE SANITARY CODE

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APPENDIX A-1

NEW YORK STATE SANITARY CODE
PART 19 REFUSE DISPOSAL

Section 19.1 Definitions.

(a) *Refuse* shall mean all putrescible and non-putrescible solid wastes including garbage, rubbish, ashes, incinerator residue, street cleanings, dead animals, offal and solid commercial and industrial wastes.

(b) *Refuse disposal area* shall mean land used for the depositing of refuse except that it shall not include the land used for the depositing of refuse from a single family, a member of which is the owner, occupant or lessee of said land, or any part of a farm on which only animal wastes resulting from the operation of such farm are deposited.

(c) *Person* shall mean an individual, group of individuals, partnership, firm, corporation, association, county, city, town or village or improvement district.

(d) *Full time health officer* shall mean the health commissioner or health officer of a city of 50,000 population or over, or of a county or part-county health district, or the State district health officer in those areas of the State not located within a county, part-county or city health district.

19.2 Refuse disposal areas.

(a) *Operation and maintenance.* Any person who maintains or operates a refuse disposal area or permits the use of land as a refuse disposal area shall maintain and operate such area in conformance with the requirements of this Part.

(1) Burning of refuse at a refuse disposal area is prohibited unless an exemption in writing is granted by the full-time health officer within whose jurisdiction said refuse disposal area is located, and provided that such exemption does not contravene the standards established by the Air Pollution Control Board.

(2) No refuse shall be deposited in such manner that refuse or leachings from it shall cause or contribute to a condition in contravention of the standards adopted pursuant to section 1205 of the Public Health Law.

(3) Dumping of refuse shall be confined to an area which can be effectively maintained and operated in accordance with these regulations. This shall be controlled by supervision, fencing, signs, or equally effective means unless an exemption in writing is granted by the full-time health officer within whose jurisdiction said refuse disposal area is located.

(4) Refuse at a refuse disposal area shall be compacted and covered daily with a compacted layer of at least six inches of a suitable cover material, and a final compacted cover of at least two feet of a suitable cover material shall be placed within one week after the final deposit of refuse at any portion of such refuse disposal area unless an exemption in writing is granted by the full time health officer within whose jurisdiction said refuse disposal area is located.

(5) Effective means shall be taken to control flies, rodents and other insects or vermin at a refuse disposal area to the extent that they shall not constitute a nuisance affecting public health.

(6) Fencing or other suitable means shall be used to confine papers and other refuse to the refuse disposal area.

(7) The salvaging of refuse at a refuse disposal area, if permitted by the operator of the refuse disposal area, shall be conducted in such a manner as not to create a nuisance affecting public health.

(8) The approach road to a refuse disposal area open to the general public shall be kept passable to vehicular traffic during all seasons of the year.

(9) The full-time health officer within whose jurisdiction a refuse disposal area is located is authorized and empowered to issue and grant annually the exemptions hereinbefore referred to, if in his judgment no nuisance or hazard to public health shall be created thereby. Any exemption hereby authorized shall expire and become void if by reason of said exemption the operation of a refuse disposal area shall be or become a nuisance or a hazard to public health or contravene any provision of this Part from the operation of which an exemption has not been granted.

(b) *New sites.* A new refuse disposal area shall not be established until the site and method of proposed operation have been approved in writing by the full-time health officer in whose respective jurisdiction such proposed refuse disposal area will be located. Such health officer is authorized to approve a new refuse disposal area if, in his judgment, it can be operated and maintained in such manner as not to constitute a nuisance or hazard to public health. The health officer may require such plans, reports, specifications, and other data as is necessary for him to determine whether the site is suitable and the proposed method of operation feasible.

19.3 Municipal Incinerators.

Municipal incinerators shall be operated and maintained so as not to create a nuisance or hazard to public health.

19.4 Adequacy of operation and maintenance.

Operation and maintenance of a refuse disposal area pursuant to subdivision (a) of section 19.2 of this Part and operation and maintenance of a municipal incinerator pursuant to section 19.3 of this Part shall be under the surveillance of the full time health

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APPENDIX A-1

NEW YORK STATE SANITARY CODE
PART 19 REFUSE DISPOSAL

Section 19.1 Definitions.

(a) *Refuse* shall mean all putrescible and non-putrescible solid wastes including garbage, rubbish, ashes, incinerator residue, street cleanings, dead animals, offal and solid commercial and industrial wastes.

(b) *Refuse disposal area* shall mean land used for the depositing of refuse except that it shall not include the land used for the depositing of refuse from a single family, a member of which is the owner, occupant or lessee of said land, or any part of a farm on which only animal wastes resulting from the operation of such farm are deposited.

(c) *Person* shall mean an individual, group of individuals, partnership, firm, corporation, association, county, city, town or village or improvement district.

(d) *Full-time health officer* shall mean the health commissioner or health officer of a city of 50,000 population or over, or of a county or part-county health district, or the State district health officer in those areas of the State not located within a county, part-county or city health district.

19.2 Refuse disposal areas.

(a) *Operation and maintenance.* Any person who maintains or operates a refuse disposal area or permits the use of land as a refuse disposal area shall maintain and operate such area in conformance with the requirements of this Part.

(1) Burning of refuse at a refuse disposal area is prohibited unless an exemption in writing is granted by the full-time health officer within whose jurisdiction said refuse disposal area is located, and provided that such exemption does not contravene the standards established by the Air Pollution Control Board.

(2) No refuse shall be deposited in such manner that refuse or leachings from it shall cause or contribute to a condition in contravention of the standards adopted pursuant to section 1205 of the Public Health Law.

(3) Dumping of refuse shall be confined to an area which can be effectively maintained and operated in accordance with these regulations. This shall be controlled by supervision, fencing, signs, or equally effective means unless an exemption in writing is granted by the full-time health officer within whose jurisdiction said refuse disposal area is located.

(4) Refuse at a refuse disposal area shall be compacted and covered daily with a compacted layer of at least six inches of a suitable cover material, and a final compacted cover of at least two feet of a suitable cover material shall be placed within one week after the final deposit of refuse at any portion of such refuse disposal area unless an exemption in writing is granted by the full-time health officer within whose jurisdiction said refuse disposal area is located.

(5) Effective means shall be taken to control flies, rodents, and other insects or vermin at a refuse disposal area to the extent that they shall not constitute a nuisance affecting public health.

(6) Fencing or other suitable means shall be used to confine papers and other refuse to the refuse disposal area.

(7) The salvaging of refuse at a refuse disposal area, if permitted by the operator of the refuse disposal area, shall be conducted in such a manner as not to create a nuisance affecting public health.

(8) The approach road to a refuse disposal area open to the general public shall be kept passable to vehicular traffic during all seasons of the year.

(9) The full-time health officer within whose jurisdiction a refuse disposal area is located is authorized and empowered to issue and grant annually the exemptions hereinbefore referred to, if in his judgment no nuisance or hazard to public health shall be created thereby. Any exemption hereby authorized shall expire and become void if by reason of said exemption the operation of a refuse disposal area shall be or become a nuisance or a hazard to public health or contravene any provision of this Part from the operation of which an exemption has not been granted.

(b) *New sites.* A new refuse disposal area shall not be established until the site and method of proposed operation have been approved in writing by the full-time health officer in whose respective jurisdiction such proposed refuse disposal area will be located. Such health officer is authorized to approve a new refuse disposal area if, in his judgment, it can be operated and maintained in such manner as not to constitute a nuisance or hazard to public health. The health officer may require such plans, reports, specifications, and other data as is necessary for him to determine whether the site is suitable and the proposed method of operation feasible.

19.3 Municipal Incinerators.

Municipal incinerators shall be operated and maintained so as not to create a nuisance or hazard to public health.

19.4 Adequacy of operation and maintenance.

Operation and maintenance of a refuse disposal area pursuant to subdivision (a) of section 19.2 of this Part and operation and maintenance of a municipal incinerator pursuant to section 19.3 of this Part shall be under the surveillance of the full-time health

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officer in whose jurisdiction said refuse disposal area or municipal incinerator is located. The full time health officer shall be charged with the duty of enforcing the sections of this Part and shall cause such inspections to be made as he may deem necessary to determine whether the operation and control of such refuse disposal area or municipal incinerator are in compliance with the provisions of this Part.

19.5 Interjurisdictional nuisances and hazards to public health.

(a) Where the operation of a refuse disposal area is conducted in such a manner as to constitute a nuisance or a hazard to public health outside a health district in which said refuse disposal area is located, the officer designated in subdivision (b) hereof shall have the authority, and it shall be his duty, on receipt of a written complaint by any person, to inquire into the facts concerning such operation. If he shall find that said operation is in contravention of any of the sections contained in this Part, he shall make and cause to be served personally or by mail upon the person operating said refuse disposal area a notice in writing stating the manner in which said operation contravenes such section or sections and specifying the particular section or sections contravened and ordering the person operating such refuse disposal area to correct or to cease such operation. If the person served as aforesaid does not comply with the requirements of such order within the time specified therein, said officer shall forthwith cause a report in writing containing a summary of the facts as disclosed by his inquiry, a recital of all action taken, and his recommendations, if any, to be transmitted to the State Commissioner of Health for such action as he may deem advisable.

(b) The officer having jurisdiction to take the action authorized and directed in subdivision (a) hereof shall be:

(1) The county or part-county health commissioner where the refuse disposal area and the residence or real property occupied by the complainant are located in the same county or part-county health district.

(2) The State district health officer where the refuse disposal area and the residence or real property occupied by the complainant are located in the same State district health area, but not in the same county or part-county health district.

(3) In all other cases, the regional health director having jurisdiction in the area in which the refuse disposal area is located.

APPENDIX A-2

NEW YORK STATE SANITARY CODE
PART 190 OPEN FIRES

Section 190.1 Definitions.

(a) Combustion products. Particulate and gaseous contaminants created by the burning of any kind of material.

(b) Commissioner. The Commissioner of Health of the State of New York.

(c) Garbage. Waste resulting from distribution, preparation and serving of foods.

(d) Open fire. Any fire or smoke-producing process wherein the combustion products are directly emitted into the atmosphere without passing through a stack.

(e) Refuse. Garbage, rubbish and trade wastes.

(f) Rubbish. Solid or liquid waste material including, but not limited to, paper, rags, ashes, tree branches, yard trimmings, furniture, tin cans, glass, crockery, demolition materials, discarded automobiles, tires, automotive parts, paints and oils.

(g) Stack. Any conduit, chimney, duct, vent, or flue arranged to conduct gaseous or gas-borne products to the outer air.

(h) Trade waste. Combustible solid or liquid material resulting from construction, or any business, trade or industry operations, including, but not limited to, the following materials: plastics, cartons, chemicals, paints, greases, oils, other petroleum products, sawdust, dead animals, and dead fowl.

190.2 Prohibitions.

No person shall burn any refuse in any open fire except in conformity with the provisions of section 190.3.

190.3 Permissible burning.

When not prohibited by other local ordinances or other officials having jurisdiction, such as the State Commissioner of Conservation or local fire wardens or other fire prevention officials, the following types of open burning are permissible:

(a) Outdoor grills and fireplaces for the purpose of preparing food.

(b) Campfires and fires used solely for recreation purposes where such fires are properly controlled by a responsible party and no nuisance is created.

(c) Backyard burning of rubbish, principally composed of paper, in the unincorporated areas of towns which have a total town population of less than 30,000, and where no public or duly licensed disposal service is available. This provision applies only to the open burning of domestic rubbish on the premises by the occupants of a building or structure used primarily for dwelling purposes and containing four or less dwelling units and when no nuisance is created.

(d) Burning of rubbish, principally tree trimmings, derived from on-premise agriculture operations and the burning of tree cuttings and slash in forest areas where the cuttings accrue from pulping, lumbering, and similar operations, when the prevailing winds, at the time of the burnings, are away from populated areas and no nuisance is created.

(e) Open burning of trees and brush, in or adjacent to highway rights-of-way, when approved by the commissioner and the State Commissioner of Public Works, and provided that prevailing winds are away from populated areas, and that dirt is removed from stumps before burning, and that tires, fuel oil, or similar materials which can cause air pollution, are not used to start fires or to keep fires burning.

(f) Open burning, in remote areas, of highly explosive or other dangerous materials for which there is no other known method of disposal or for special purposes or under unusual circumstances when approved by the commissioner after having requested permission on appropriate forms and when no nuisance is created.

(g) Burning of solid or liquid fuels or structures when conducted under the direct control and supervision of qualified instructors at a firemen's training center and when done for the instruction and training of firemen.

(h) Properly operated industrial flares for combustion of flammable gases.

190.4 Abatement.

(a) Open burning of refuse at refuse disposal areas, where allowed by the full-time health officer, must be replaced by a suitable means of disposal not later than January 1, 1969 or such later date, as determined by a final order after a formal hearing held by the commissioner.

(b) Open burning of refuse, otherwise permissible under section 190.3, shall not be carried on when the commissioner announces a period of high air pollution potential.

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APPENDIX B

ADDITIONAL TABLES AND FIGURES

TABLE 16

FACILITY THROUGHPUT IN TONS PER HOUR

Date Jan. '74	Tons Received	Tons Per Hr.
1	0	0
2	264.5	33.9
3	237.6	37.7
4	0	0
5	150.0	30.0
6	0	0
7	156.4	29.0
8	156.4	32.6
9	173.6	40.4
10	233.5	37.1
11	235.5	37.4
12	0	0
13	0	0
14	213.9	37.5
15	223.4	30.2
16	169.5	33.9
17	244.9	35.0
18	210.4	32.9
19	0	0
20	0	0
21	260.2	39.4
22	269.3	39.0
23	186.8	36.6
24	226.6	40.5
25	238.0	35.0
26	0	0
27	0	0
28	122.6	38.3
29	277.4	42.2
30	228.4	42.2
31	169.8	26.1
Average Per Production Day	211.3	35.8

TABLE 17

FACILITY THROUGHPUT IN TONS PER HOUR

Date Feb. '74	Tons Received	Tons Per Hr.
1	248.9	35.5
2	0	0
3	0	0
4	100.9	22.9
5	222.2	34.7
6	229.9	35.3
7	290.9	42.7
8	271.2	36.6
9	0	0
10	0	0
11	256.5	40.7
12	231.8	38.0
13	257.8	37.9
14	256.2	37.1
15	263.7	34.2
16	0	0
17	0	0
18	294.2	40.3
19	230.2	41.8
20	254.4	41.0
21	265.8	39.0
22	267.6	43.8
23	0	0
24	0	0
25	296.0	39.4
26	287.8	35.5
27	290.9	35.0
28	274.8	36.6
Average Per Production Day	254.6	37.4

TABLE 18

FACILITY THROUGHPUT IN TONS PER HOUR

Date Mar. '74	Tons Received	Tons Per Hr.
1	283.4	36.3
2	0	0
3	0	0
4	0	0*
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	282.7	37.7
20	244.4	33.5
21	259.4	35.5
22	303.8	37.5
23	260.9	37.3
24	0	0
25	293.3	37.6
26	244.8	34.0
27	259.6	34.6
28	261.4	32.3
29	275.5	34.9
30	0	0
31	0	0
Average Per Production Day	269.9	35.6

*Plant shut down for major maintenance between March 4 and March 18, 1974.

TABLE 19

FACILITY THROUGHPUT IN TONS PER HOUR

Date April '74	Tons Received	Tons Per Hr.
1	289.5	41.4
2	319.1	40.4
3	256.6	36.7
4	250.3	31.3
5	301.1	45.7
6	0	0
7	0	0
8	260.9	38.9
9	277.4	43.3
10	304.4	39.0
11	301.4	43.7
12	249.3	37.8
13	0	0
14	0	0
15	309.8	40.8
16	296.7	37.6
17	288.2	37.9
18	252.0	36.5
19	271.1	37.6
20	0	0
21	0	0
22	249.0	35.6
23	253.2	38.4
24	253.0	37.8
25	260.6	38.3
26	277.3	39.6
27	0	0
28	0	0
29	262.3	42.3
30	281.5	40.8
Average Per Production Day	275.7	39.2

TABLE 20

FACILITY THROUGHPUT IN TONS PER HOUR

Date May '74	Tons Received	Tons Per Hr.
1	275.0	40.4
2	244.0	37.5
3	276.0	35.8
4	0	0
5	0	0
6	154.0	37.6
7	0	0
8	232.2	31.0
9	259.3	47.1
10	272.1	39.4
11	0	0
12	0	0
13	246.5	37.9
14	301.4	48.6
15	207.0	39.8
16	175.0	34.3
17	257.6	40.9
18	0	0
19	0	0
20	247.2	41.9
21	225.9	37.7
22	182.9	
23	296.3	47.0
24	241.1	37.1
25	0	0
26	0	0
27	0	0
28	271.7	36.2
29	263.5	41.8
30	312.2	40.0
31	282.9	41.0
Average Per Production Day	237.4	39.6

TABLE 21

FACILITY THROUGHPUT IN TONS PER HOUR

Date June '74	Tons Received	Tons Per Hr.
1	220.6	40.9
2	0	0
3	267.0	39.9
4	261.5	37.9
5	238.1	39.0
6	277.0	44.7
7	241.4	36.6
8	0	0
9	0	0
10	27.5	0
11	42.8	43.9
12	249.8	39.0
13	370.9	48.8
14	248.7	35.5
15	0	0
16	0	0
17	15.5	0
18	308.9	47.0
19	267.6	43.9
20	143.4	41.0
21	0	0
22	0	0
23	0	0
24	300.8	45.6
25	295.0	50.0
26	312.1	45.2
27	297.7	48.0
28	189.4	40.3
29	0	0
30	0	0
Average Per Production Day	228.8	42.6

TABLE 22

FACILITY THROUGHPUT IN TONS PER HOUR

Date July '74	Tons Received	Tons Per Hr.
1	242.1	48.4
2	242.6	41.1
3	340.6	60.8
4	0	0
5	289.9	46.0
6	231.0	55.0
7	0	0
8	305.3	50.9
9	278.7	51.6
10	257.0	51.4
11	268.9	42.7
12	252.4	40.7
13	0	0
14	0	0
15	272.4	43.9
16	255.5	45.6
17	258.2	39.1
18	310.7	49.3
19	292.2	46.4
20	0	0
21	0	0
22	225.6	48.0
23	186.4	42.4
24	331.8	53.5
25	361.0	52.3
26	225.6	44.2
27	0	0
28	0	0
29	390.4	61.0
30	344.8	75.0
31	409.5	65.0
Average Per Production Day	285.8	50.2

TABLE 23

FACILITY THROUGHPUT IN TONS PER HOUR

Date August '74	Tons Received	Tons Per Hr.
1	377.1	69.8
2	354.8	61.2
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	334.1	48.4
9	313.7	52.3
10	0	0
11	0	0
12	321.4	48.0
13	306.2	50.2
14	299.8	50.8
15	179.4	51.3
16	311.6	43.9
17	0	0
18	0	0
19	385.9	59.4
20	371.0	55.4
21	321.1	49.4
22	350.5	52.3
23	326.2	50.2
24	0	0
25	0	0
26	268.4	53.7
27	347.8	47.6
28	265.1	54.1
29	382.1	60.7
30	353.4	57.9
31	0	0
Average Per Production Day	324.7	53.5

TABLE 24

FACILITY THROUGHPUT IN TONS PER HOUR

Date Sept. '74	Tons Received	Tons Per Hr.
1	0	0
2	0	0
3	444.3	76.6
4	422.4	72.8
5	457.5	60.2
6	429.6	60.5
7	352.8	55.1
8	0	0
9	380.7	57.7
10	392.9	57.8
11	235.0	44.3
12	370.7	58.8
13	323.5	55.8
14	0	0
15	0	0
16	382.3	65.9
17	421.5	59.4
18	292.0	62.1
19	298.2	71.0
20	335.3	56.8
21	0	0
22	0	0
23	221.6	63.4*
24	279.1	63.4
25	382.0	63.7
26	276.1	58.7
27	306.6	62.6
28	0	0
29	0	0
30	389.0	63.8
Average Per Production Day	352.1	61.4

*September 23, 1974, some refuse left overnight. Production rate is rate for two days, September 23, September 24.

TABLE 25

FACILITY THROUGHPUT IN TONS PER HOUR

Date Oct. '74	Tons Received	Tons Per Hr.
1	372.9	62.2
2	336.8	60.1
3	359.6	76.5
4	302.5	60.5
5	0	0
6	0	0
7	404.4	69.7
8	353.0	56.0
9	302.7	58.2
10	367.0	62.2
11	355.5	51.5
12	0	0
13	0	0
14	386.5	67.8
15	361.4	68.2
16	321.2	58.4
17	343.3	62.4
18	51.7	25.8
19	0	0
20	0	0
21	393.1	60.5
22	418.0	60.6
23	331.2	59.1
24	364.6	60.8
25	351.4	54.9
26	0	0
27	0	0
28	152.7	58.7
29	396.3	61.0
30	351.5	61.7
31	394.1	59.7
Average Per Production Day	337.9	59.8

TABLE 26

FACILITY THROUGHPUT IN TONS PER HOUR

Date Nov. '74	Tons Received	Tons Per Hr.
1	227.7	59.9
2	0	0
3	0	0
4	413.1	71.2
5	417.1	64.2
6	395.8	69.4
7	393.9	72.9
8	367.7	61.3
9	0	0
10	0	0
11	342.0	61.1
12	376.7	61.8
13	386.9	73.0
14	403.8	72.1
15	314.9	70.0
16	0	0
17	0	0
18	295.7	59.1
19	345.5	60.6
20	367.5	63.4
21	339.1	69.2
22	317.0	62.2
23	0	0
24	0	0
25	326.4	58.3
26	321.5	63.0
27	286.8	54.1
28	0	0
29	321.9	65.7
30	250.8	64.3
Average Per Production Day	343.4	64.6

TABLE 27

FACILITY THROUGHPUT IN TONS PER HOUR

Date Dec. '74	Tons Received	Tons Per Hr.
1	0	0
2	352.1	67.7
3	355.3	68.3
4	302.6	63.0
5	381.0	68.0
6	294.2	58.8
7	0	0
8	0	0
9	308.7	51.4
10	307.1	55.8
11	205.1	52.6
12	319.9	60.4
13	317.8	55.8
14	0	0
15	0	0
16	351.0	61.6
17	330.5	63.6
18	286.7	56.2
19*	156.5	54.0
20	264.9	47.3
21	0	0
22	0	0
23*	0	0
24*	211.2	49.1
25	Xmas	
26*	163.9	48.2
27*	238.7	47.7
28	289.5	56.8
29	0	0
30*	0	0
31*	0	0
Average Per Production Day	286.1	57.2

*Also ran Shredder in Unit No. 2.

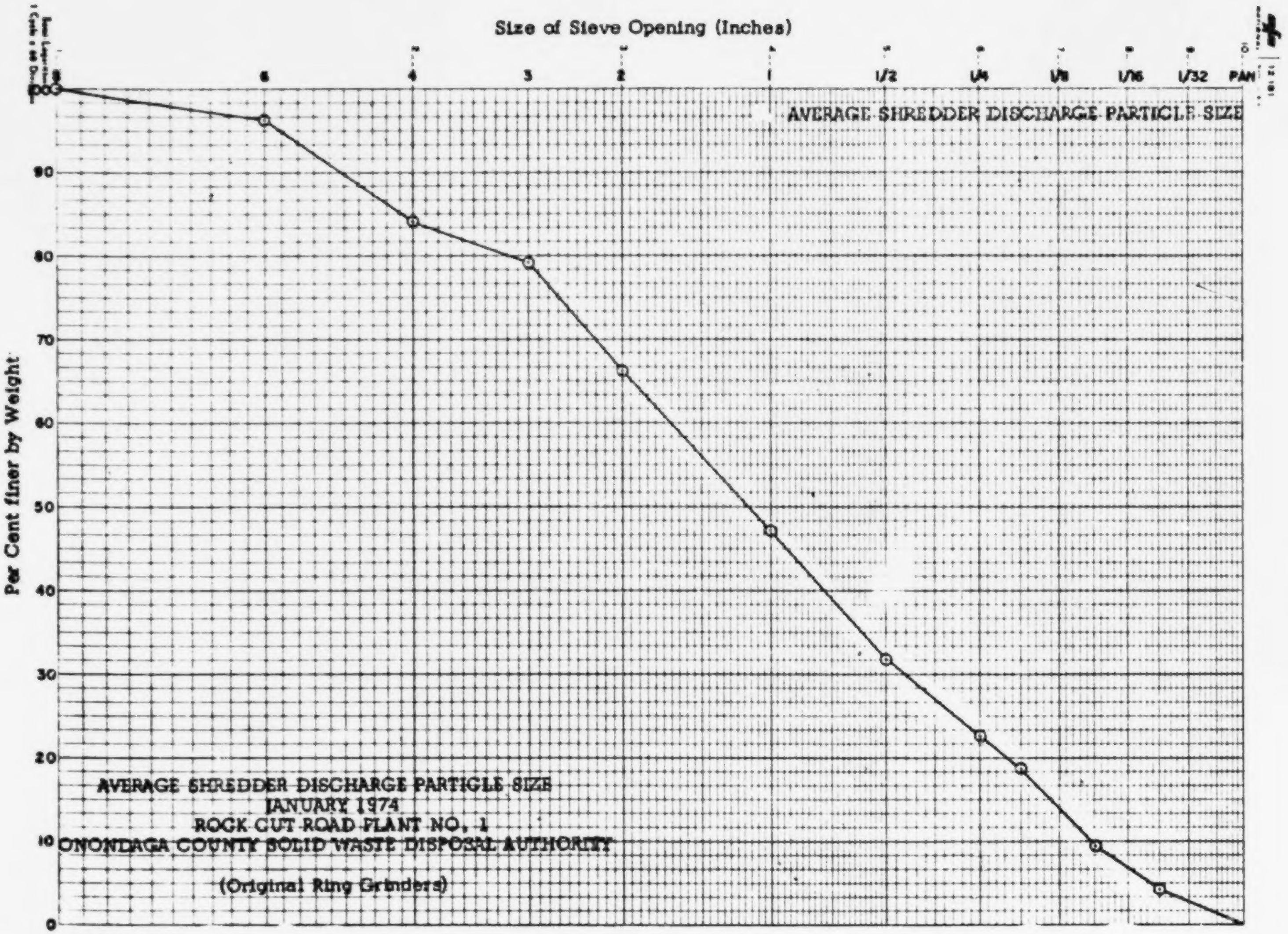
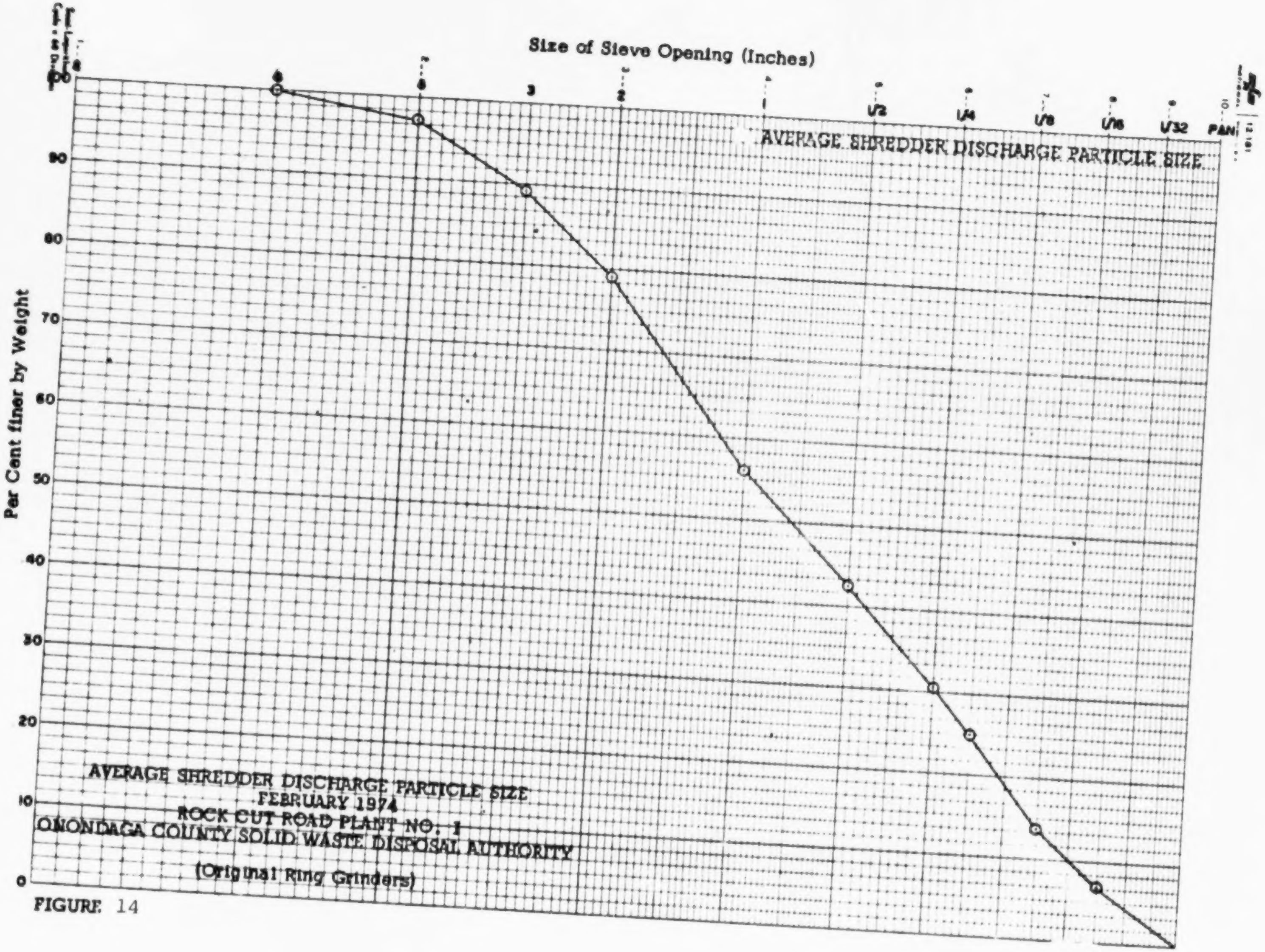

Size of Sieve Opening (Inches)
8
6
4
3
2
1
1/2
1/4
1/8
1/16
1/32
PAN
AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
Per Cent finer by Weight
100
90
80
70
60
50
40
30
20
10
0
AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
JANUARY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
(Original Ring Grinders)

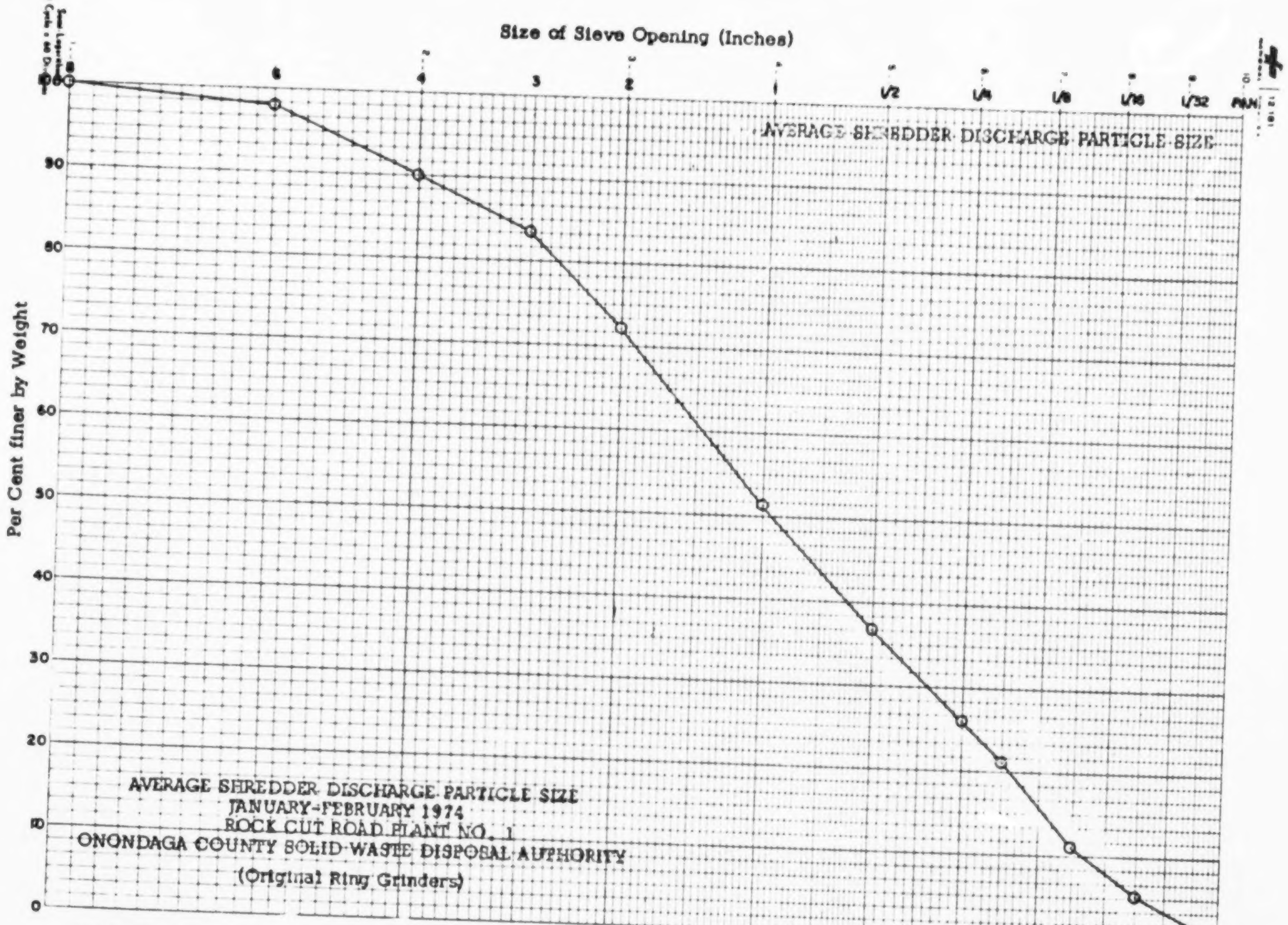
FIGURE 13



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
FEBRUARY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

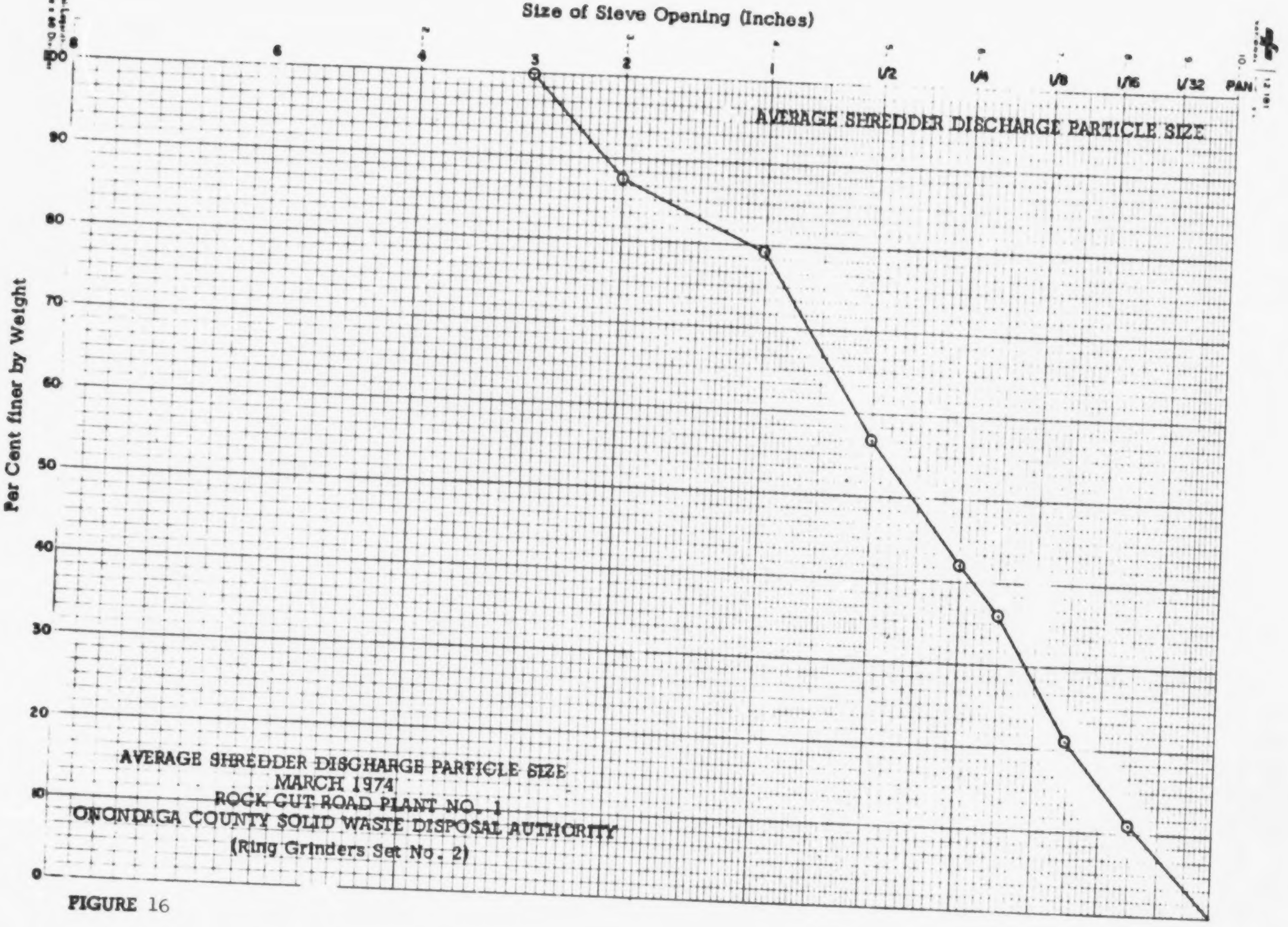
(Original Ring Grinders)

FIGURE 14



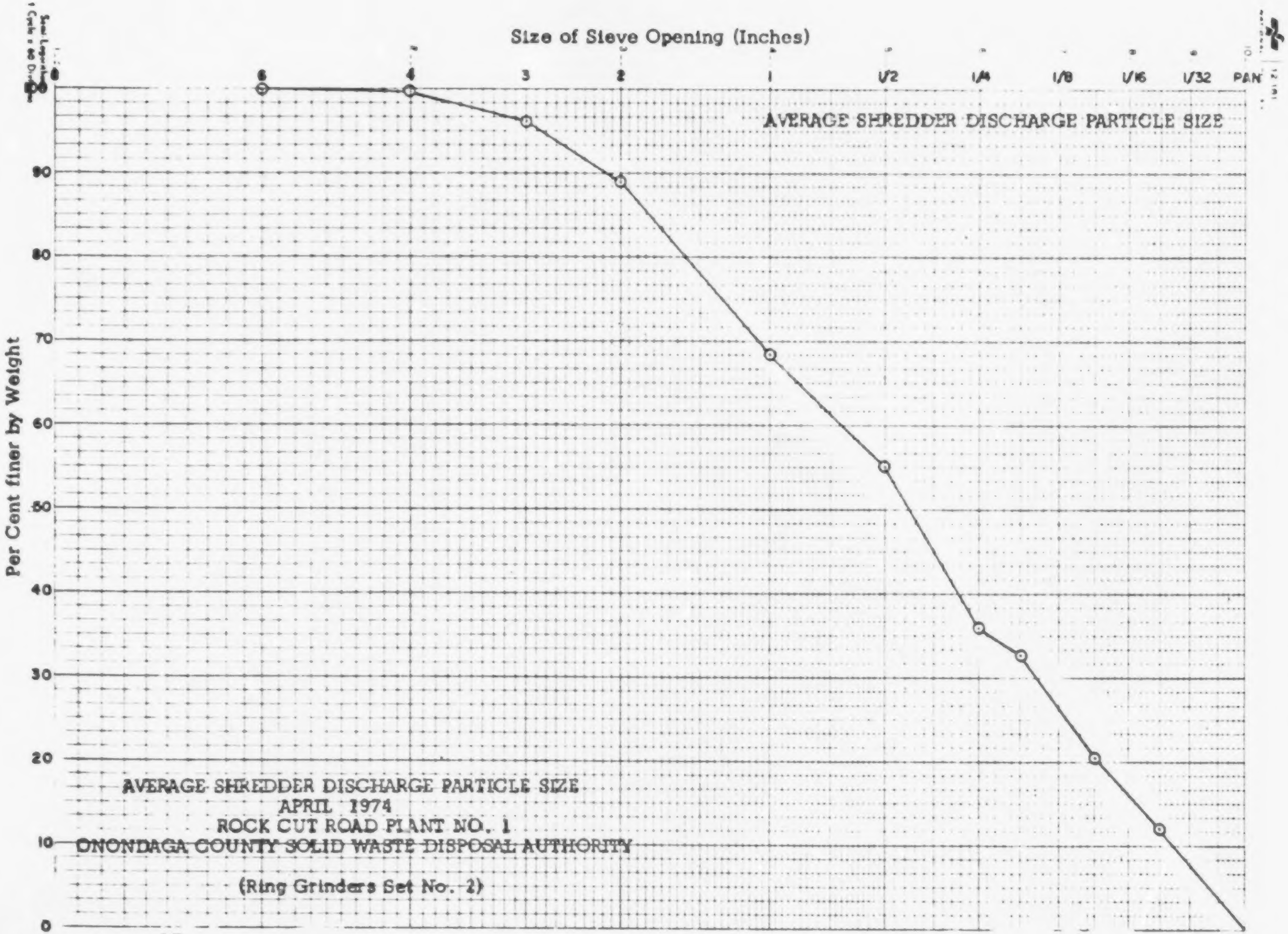
AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
JANUARY-FEBRUARY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
(Original Ring Grinders)

FIGURE 15



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
MARCH 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
(Ring Grinders Set No. 2)

FIGURE 16

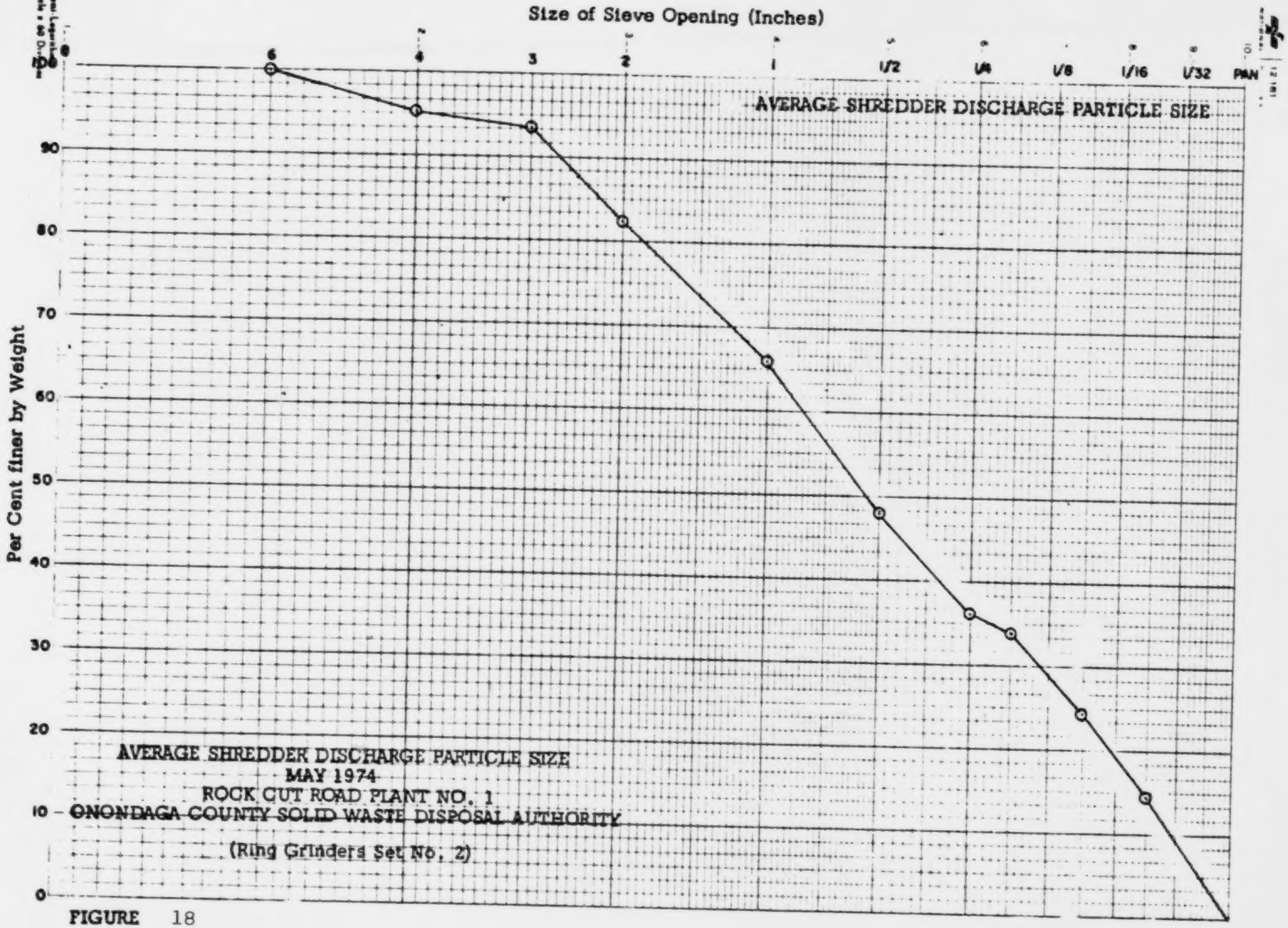


AVERAGE SHREDDER DISCHARGE PARTICLE SIZE

AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
APRIL 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 2)

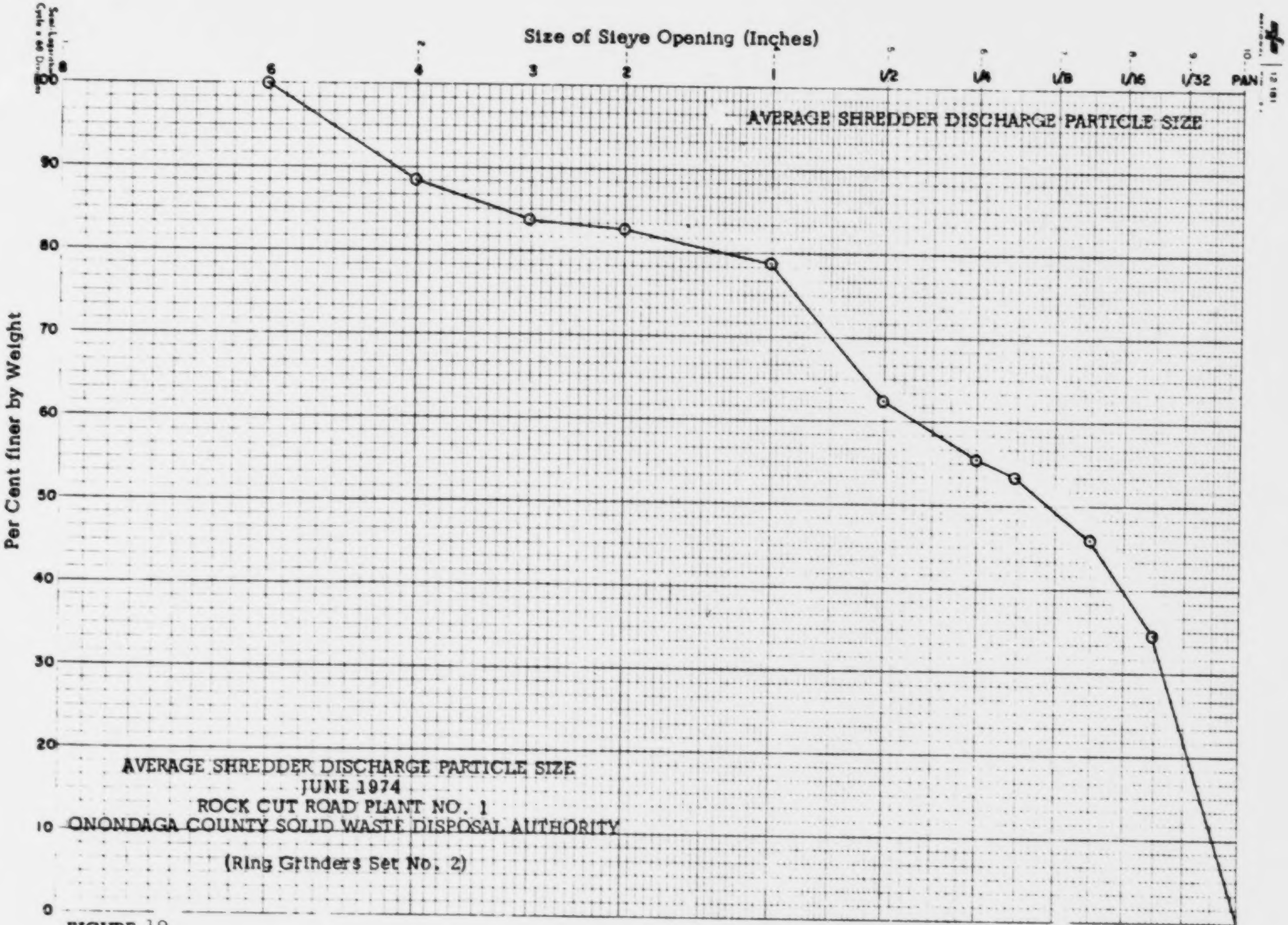
FIGURE 17



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
MAY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 2)

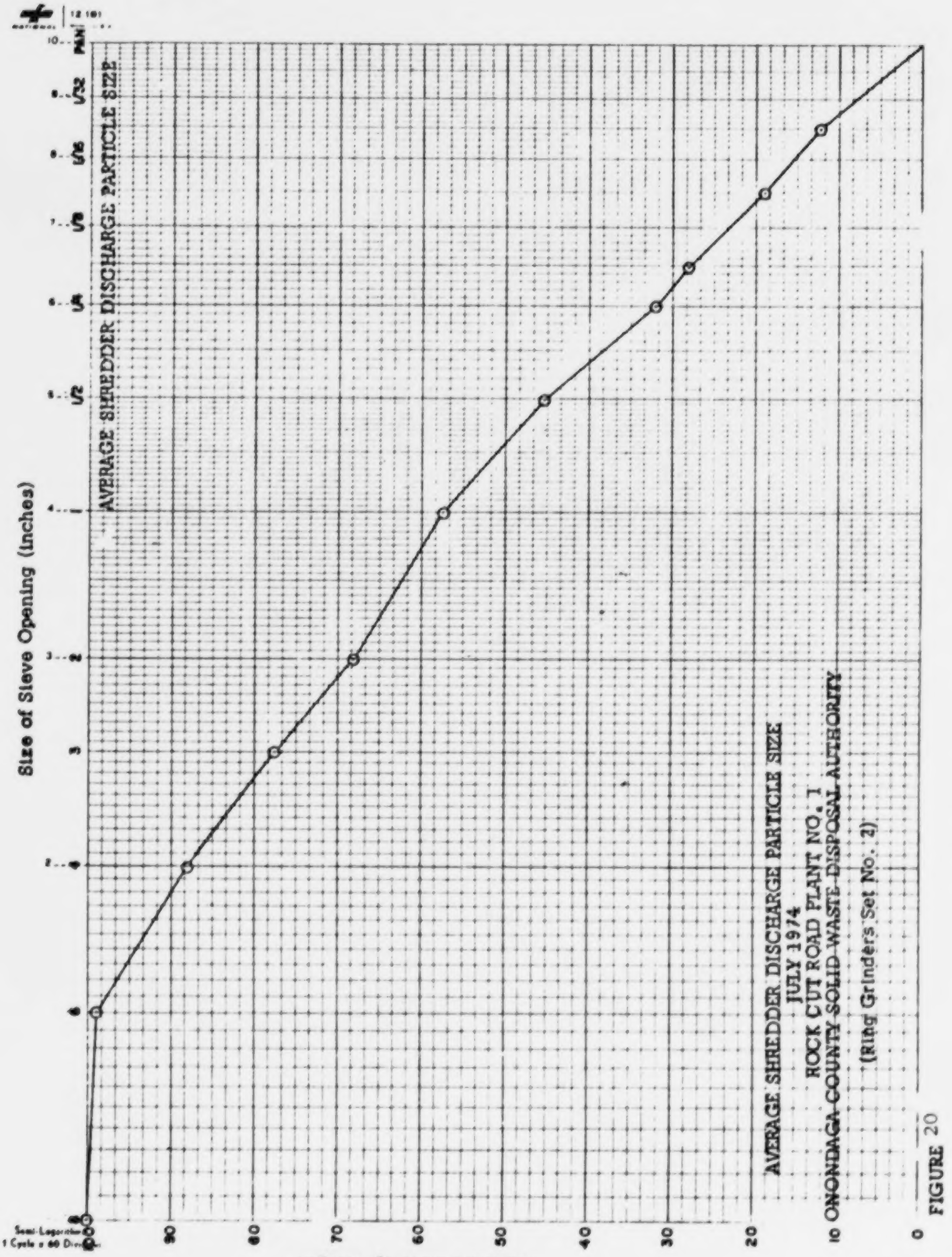
FIGURE 18



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
JUNE 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

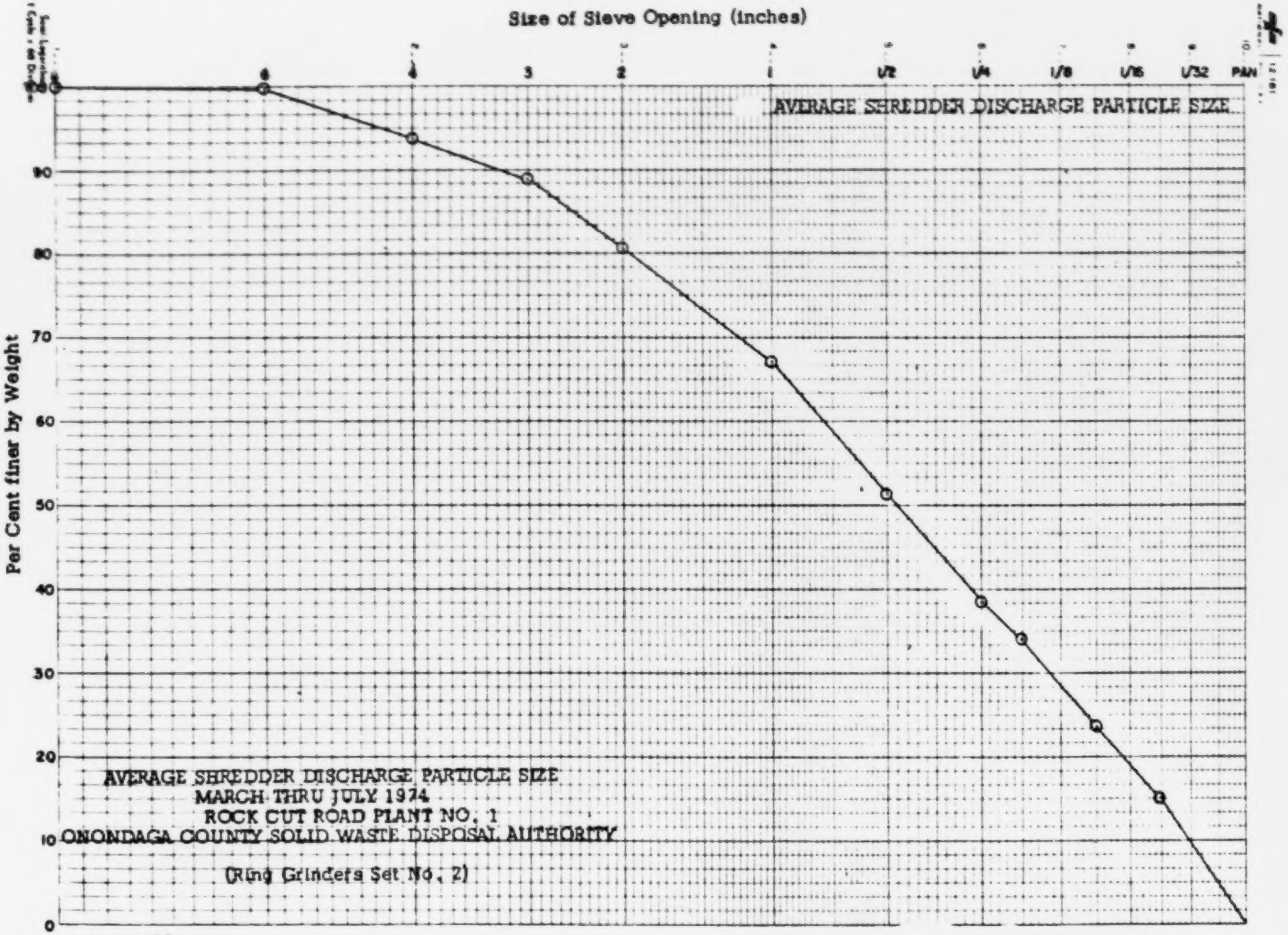
(Ring Grinders Set No. 2)

FIGURE 19



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
JULY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
(Ring Grinders Set No. 2)

FIGURE 20

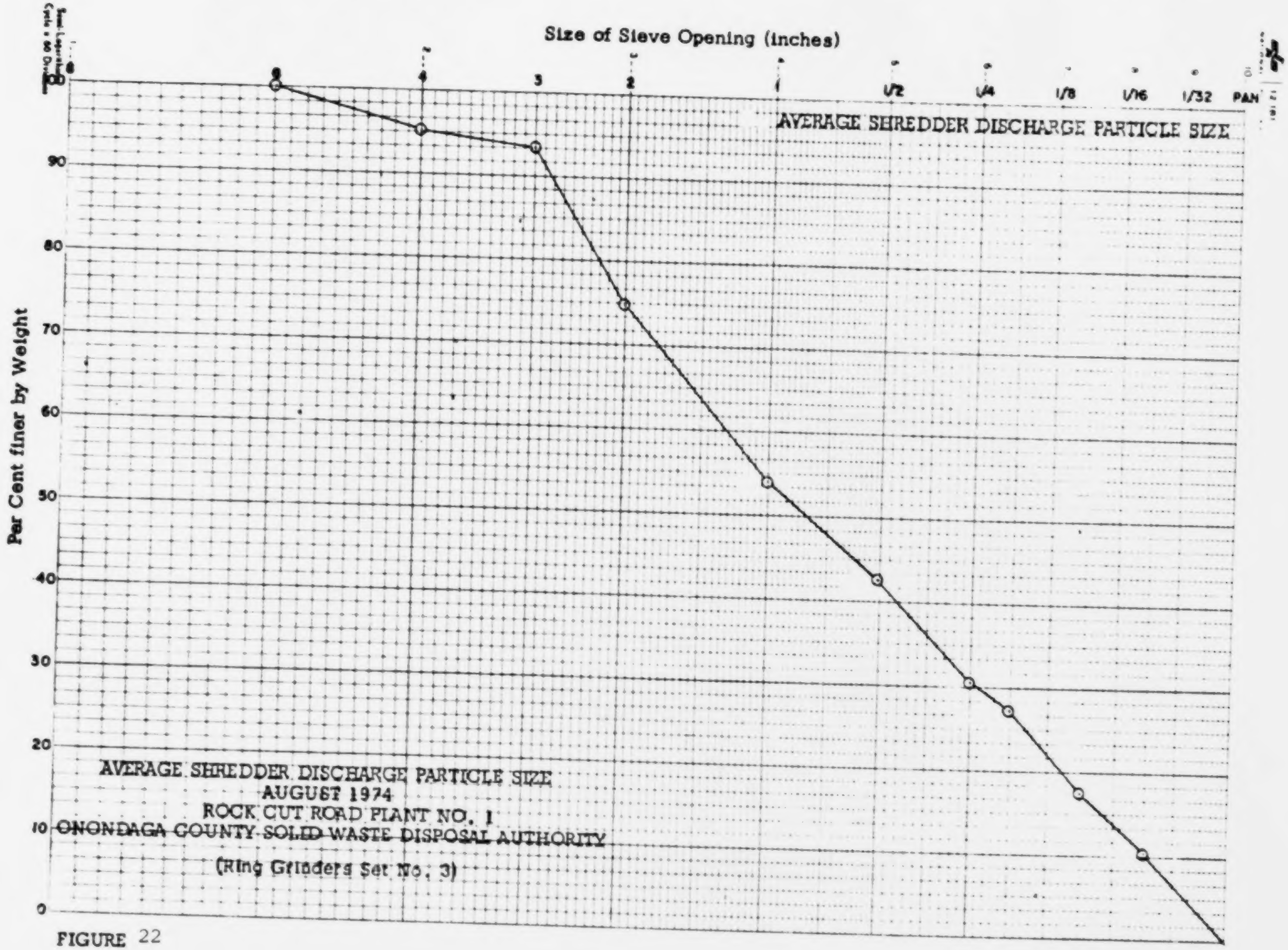


AVERAGE SHREDDER DISCHARGE PARTICLE SIZE

AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
MARCH THRU JULY 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 2)

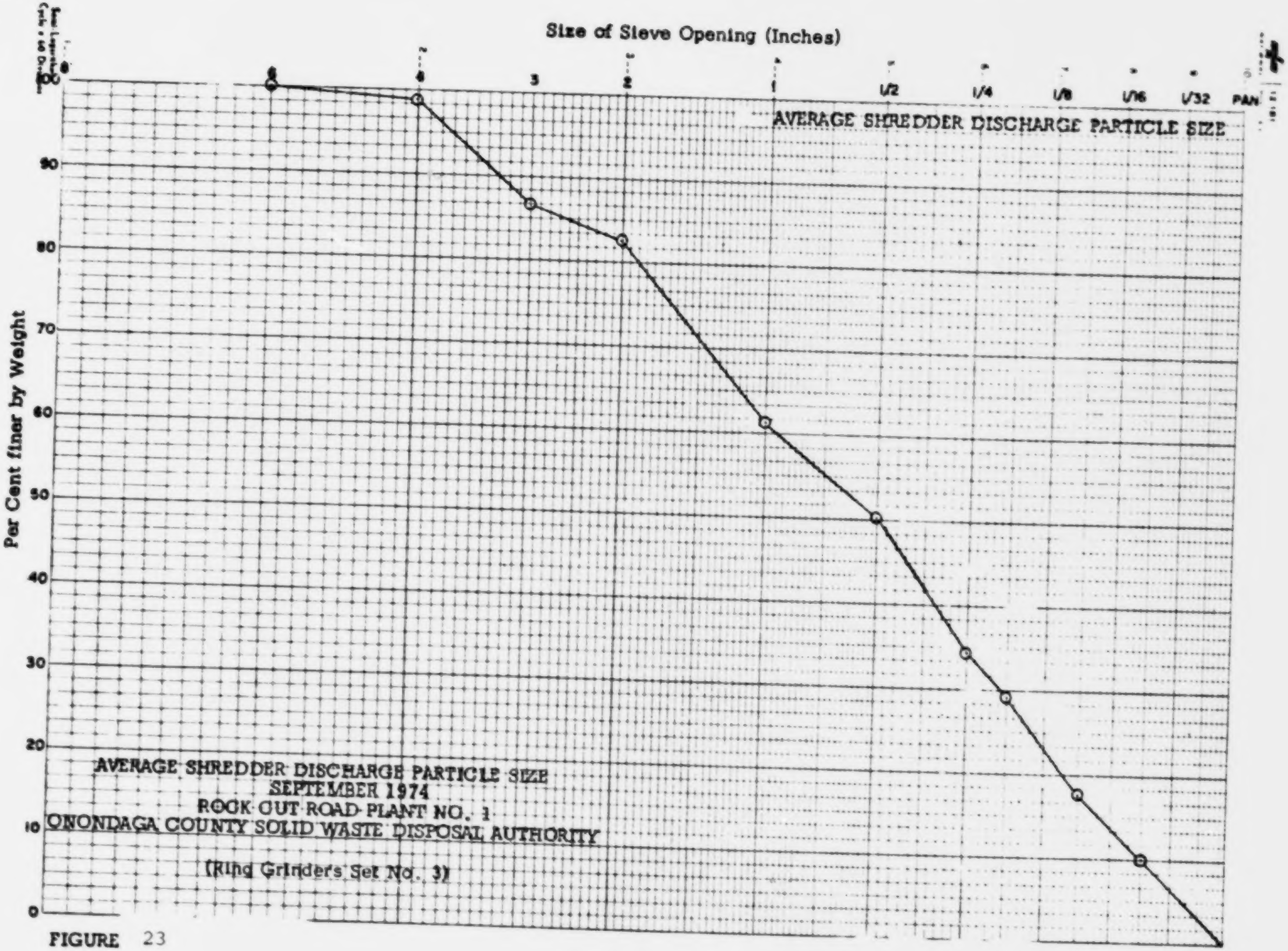
FIGURE 21



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
AUGUST 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 3)

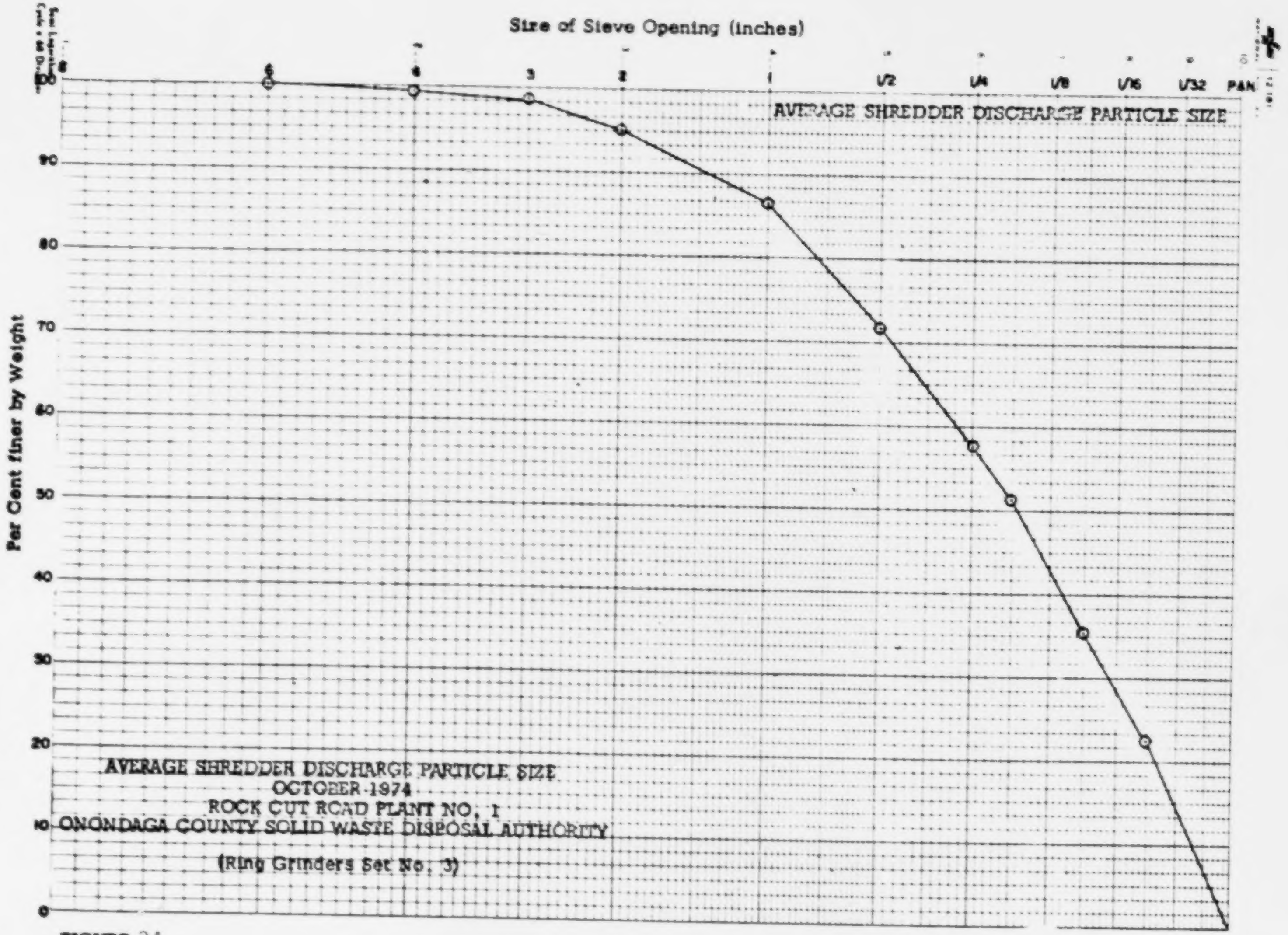
FIGURE 22



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
SEPTEMBER 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 3)

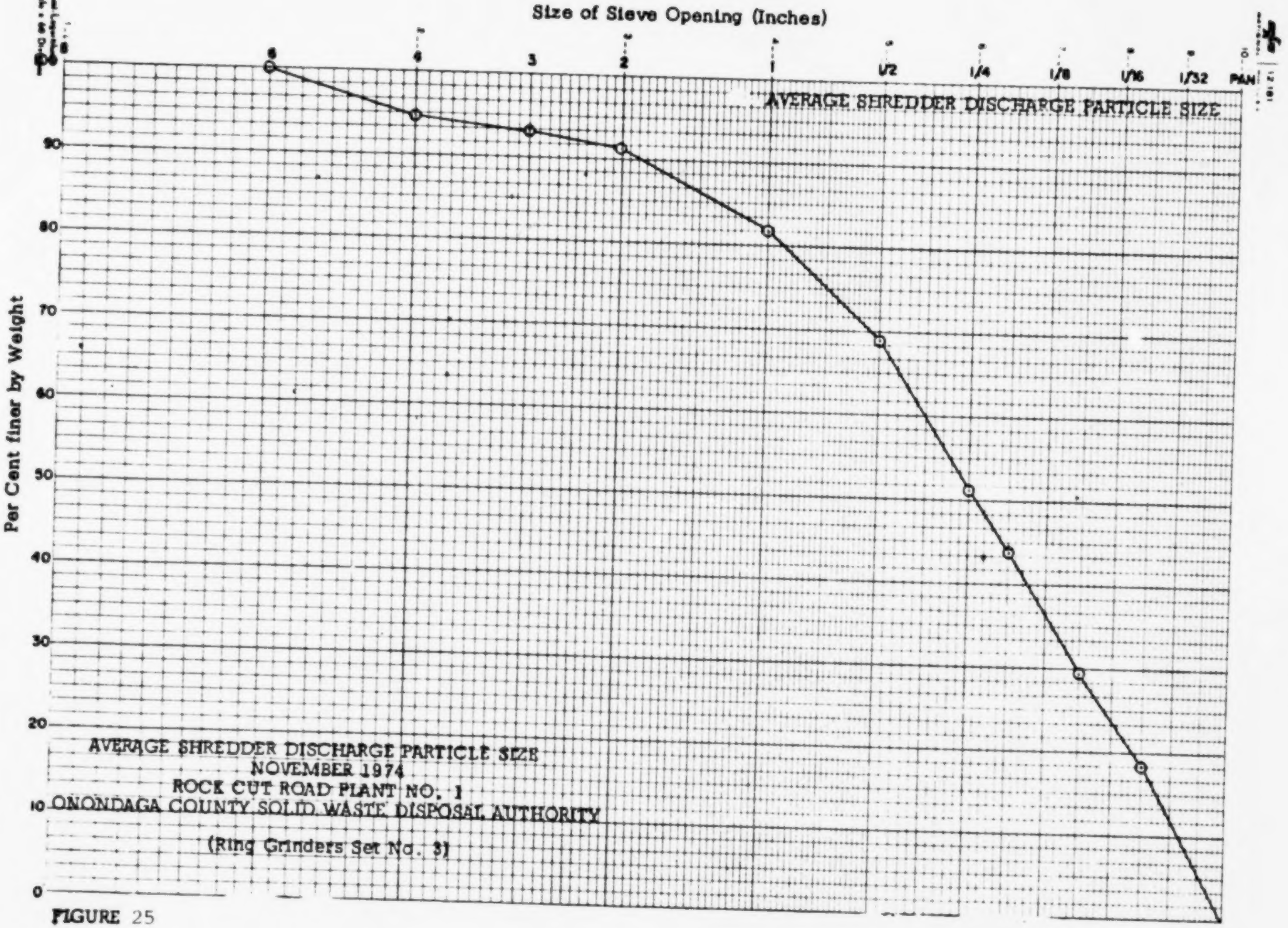
FIGURE 23



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
OCTOBER 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 3)

FIGURE 24



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
NOVEMBER 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinders Set No. 3)

FIGURE 25

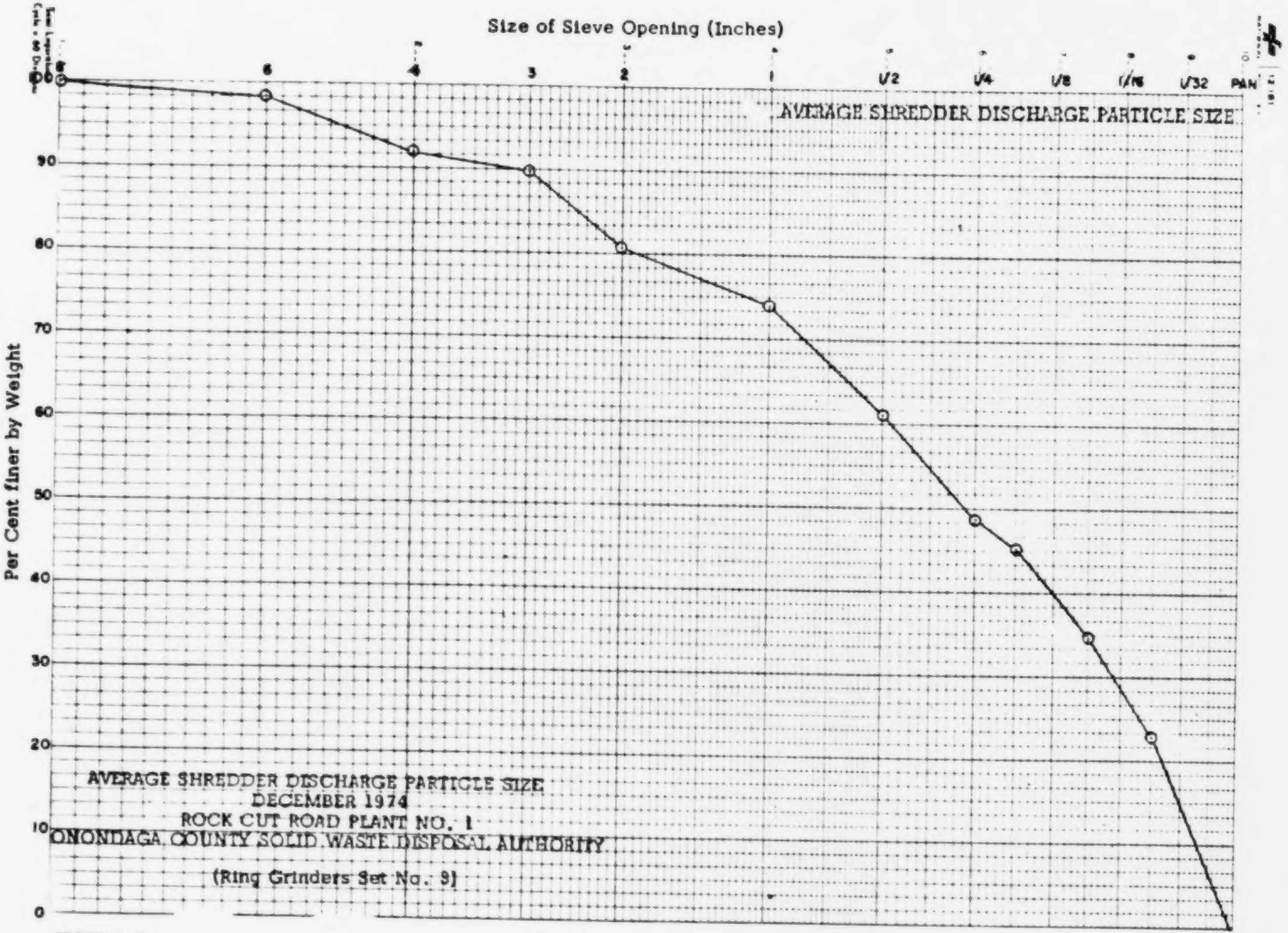
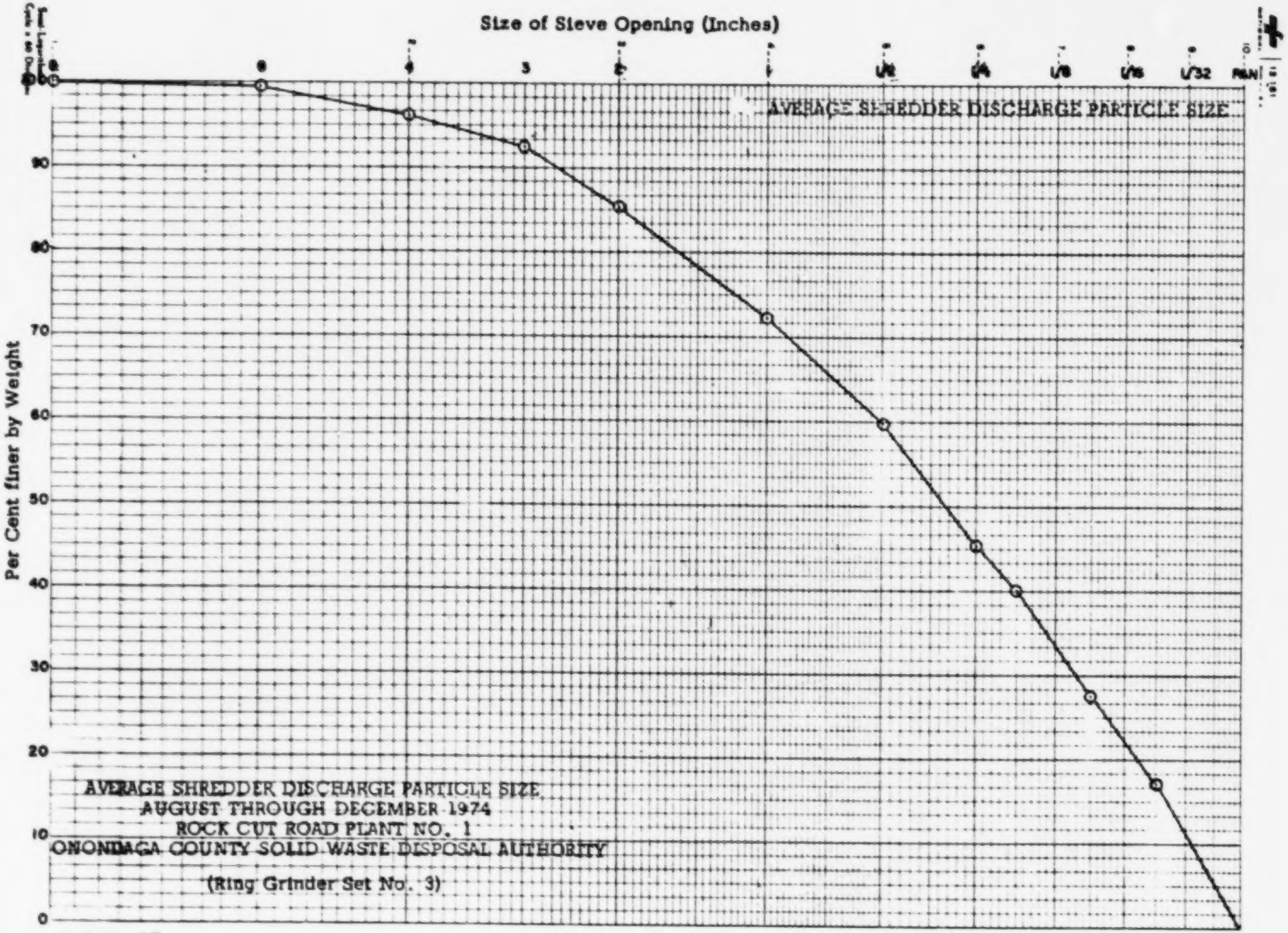

Size of Sieve Opening (Inches)
Per Cent finer by Weight
8
6
4
3
2
1
1/2
1/4
1/8
1/16
1/32
PAN
100
90
80
70
60
50
40
30
20
10
0
AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
DECEMBER 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY
(Ring Grinders Set No. 9)

FIGURE 26



AVERAGE SHREDDER DISCHARGE PARTICLE SIZE
AUGUST THROUGH DECEMBER 1974
ROCK CUT ROAD PLANT NO. 1
ONONDAGA COUNTY SOLID WASTE DISPOSAL AUTHORITY

(Ring Grinder Set No. 3)

FIGURE 27

TABLE 28

WEAR ON RING TYPE GRINDERS
SET NO. 1*

Grinder No.	Wear Maximum (inches)+	Wear Minimum (inches)	Grinder No.	Wear Maximum (inches)	Wear Minimum (inches)
1	1 1/2	1/2	31	1 9/16	1/4
2	1 1/8	1/2	32	1 1/2	11/16
3	1 13/16	5/16	33	1 1/2	11/16
4	1 5/8	3/4	34	1 1/4	9/16
5	2	1/2	35	1 9/16	3/8
6	1 1/8	5/16	36	1 3/8	3/8
7	1 3/4	3/4	37	1 3/8	7/16
8	1 5/8	11/16	38	5/8	3/8
9	1 5/8	3/4	39	7/16	3/4
10	1 5/8	13/16	40	1 1/8	1/4
11	1	3/8	41	1 3/16	5/8
12	1	3/8	42	1 5/8	9/16
13	1 3/8	3/8	43	1 11/16	5/8
14	1	3/8	44	1 7/8	3/8
15	1 5/8	3/4	45	1 1/4	3/8
16	1 5/16	5/8	46	1	7/16
17	2 1/8	3/8	47	1 15/16	3/4
18	1 1/8	1/4	48	1 9/16	5/16
19	1 15/16	9/16	49	1 3/16	7/16
20	2	5/8	50	1 1/2	3/8
21	2	11/16	51	1 3/8	1/2
22	1 7/16	7/16	52	1 3/8	5/8
23	1 15/16	5/8	53	1 1/4	1/2
24	1 3/4	3/8	54	1 1/2	5/8
25	1 5/8	1/4	55	1	1/2
26	1 7/8	3/8	56	1 1/4	1/4
27	1 1/2	3/4	57	1 1/8	5/16
28	1 3/8	3/8	58	1 1/8	3/8
29	1 1/2	11/16	59	7/8	3/8
30	1 5/8	7/16	60	1	1/4

*These are the original ring type grinders. They were in use in January and February 1974.

+Original dimension from circumference of bore to outer edge of tooth was 3 3/4 inches.

TABLE 29

WEAR ON RING TYPE GRINDERS
SET NO. 2*

Grinder No.	Wear Maximum (inches)+	Wear Minimum (inches)	Grinder No.	Wear Maximum (inches)	Wear Minimum (inches)
1	1 5/8	1	21	1 5/8	1
2	1 3/8	9/16	22	1 7/16	11/16
3	1 7/8	1 3/16	23	1 5/8	1/2
4	1 7/8	5/8	24	1 9/16	3/4
5	1 7/8	11/16	25	1 13/16	11/16
6	1 9/16	1 1/8	26	1 7/8	3/4
7	1 13/16	15/16	27	2	15/16
8	1 3/4	3/8	28	2 7/16	1
9	1 3/16	11/16	29	2	1
10	1 13/16	9/16	30	1 7/8	1
11	1 5/8	15/16	31	1 1/2	15/16
12	1 5/8	9/16	32	1 3/8	3/4
13	1 1/2	5/8	33	1 3/4	3/4
14	1 5/8	3/4	34	1 1/2	7/16
15	1 9/16	5/8	35	1 5/8	15/16
16	1 5/8	5/8	36	1 7/16	5/8
17	1 1/2	5/8	37	1 7/16	13/16
18	1 9/16	5/8	38	1 1/4	5/8
19	1 3/4	15/16	39	2 3/16	13/16
20	1 3/4	1	40	1 3/4	7/8
			41‡	1 5/8	1

*These are the first replacement ring type grinders. They were in use from March through July 1974.

+Original dimension from circumference of bore to outer edge of tooth was 3 3/4 inches.

‡Only 41 of 61 ring type grinders were measured. The other 19 were scrapped before measurements could be made.

TABLE 30

WEAR ON RING TYPE GRINDERS
SET NO. 3*

	Wear			Wear	
Grinder No.	Maximum (inches)+	Minimum (inches)	Grinder No.	Maximum (inches)	Minimum (inches)
1	1 7/8	5/8	31	1 7/8	1
2	1 13/16	3/4	32	1 3/4	3/4
3	1 7/8	3/4	33	2 1/4	1 1/8
4	2 9/16	15/16	34	2	9/16
5	2 3/8	1 1/4	35	1 3/4	7/8
6	2	1 1/16	36	1 13/16	15/16
7	2 1/4	15/16	37	1 13/16	15/16
8	2 1/16	15/16	38	1 13/16	1/2
9	2 5/8	15/16	39	1 7/8	7/8
10	2 1/8	3/4	40	1 13/16	3/4
11	1 3/4	1 1/8	41	2 1/8	7/8
12	1 5/8	7/8	42	2	1 1/8
13	1 3/4	7/8	43	2	9/16
14	1 7/8	5/8	44	1 5/8	3/4
15	1 13/16	1	45	1 15/16	1
16	2 1/4	1	46	2 1/4	15/16
17	1 7/8	15/16	47	1 7/8	5/8
18	2 1/4	3/4	48	1 3/4	5/8
19	2 1/4	15/16	49	1 15/16	3/8
20	2 1/2	1	50	2 1/2	1 1/8
21	2 7/8	3/8	51	2 1/8	5/8
22	2 5/16	1 1/8	52	1 13/16	3/4
23	1 3/4	1	53	1 15/16	1 1/8
24	1 15/16	15/16	54	1 7/8	1
25	1 7/8	1 1/4	55	2 1/2	1/2
26	2	3/4	56	3	13/16
27	2 11/16	1 1/4	57	1 5/8	1
28	2 1/2	1 1/4	58	1 3/4	1/2
29	2 7/8	1 5/16	59	1 13/16	7/8
30	2 11/16	1	60	2 3/8	1 1/8

*These are the second replacement of ring type grinders. They were in use from August 1974 through April 1975.

+Original dimension from circumference of bore to outer edge of tooth was 3 3/4 inches.

TABLE 31

DAILY PRODUCTION CHART

Date Jan. '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	0		0	0	Holiday
2	9.0		1.2	7.8	Shear pin failure, infeed conveyor
3	7.1		0.8	6.3	Christmas tree jam up
4	0		0	0	Christmas tree jam up plus scales not working
5	6.0		1.0	5.0	Christmas tree jam up
6	0		0	0	Sunday
7	6.9		1.5	5.4	Christmas tree jam up
8	6.4		1.6	4.8	Christmas tree jam up
9	6.4	1.3	0.8	4.3	Transfer conveyor down due to weld failure
10	9.4		3.1	6.3	Paper jam up (cardboard)
11	8.0		1.7	6.3	Paper jam up (cardboard)
12	0		0	0	
13	0		0	0	Sunday
14	8.8		3.1	5.7	Cardboard jam plus transfer truck out of service
15	9.3		1.9	7.4	Cardboard jam
16	6.6		1.6	5.0	Metal Obstacles in refuse
17	7.7		0.7	7.0	Metal obstacles in refuse
18	8.1		1.7	6.4	Delay due to assistance in unloading hopper for Unit No. 2
19	0		0	0	
20	0		0	0	Sunday
21	8.7		2.1	6.6	Metal obstacles in refuse
22	9.2		2.3	6.9	Metal obstacles in refuse
23	8.0	1.2	1.7	5.1	Electrical malfunction on infeed conveyor
24	7.9		2.3	5.6	Metal obstacles in refuse
25	8.7		1.9	6.8	Metal obstacles in refuse
26	0		0	0	
27	0		0	0	Sunday
28	7.8	4.5	0.1	3.2	Transfer conveyor bearing failure
29	5.3		0.8	4.5	Production halted due to construction Unit No. 2 interference, material left on dump floor
30	9.3		1.8	7.5	Shear pin failure
31	8.2		1.7	6.5	Excessive cans of mincemeat

TABLE 32

DAILY PRODUCTION CHART

Date Feb. '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	8.6		1.6	7.0	Miscellaneous iron, hard gears, axles
2	0		0	0	
3	0		0	0	Sunday
4	7.0		2.6	4.4	Excessive paper (1) Transfer truck down
5	8.0		1.6	6.4	Miscellaneous iron, waiting for transfer trucks
6	7.4		.9	6.5	Broke shear pins, miscellaneous iron
7	7.5		.7	6.8	No problems
8	8.8		1.4	7.4	Waiting on transfer truck, miscellaneous iron
9	0		0	0	
10	0		0	0	Sunday
11	8.0		1.7	6.3	Bridges & iron (hood jams)
12	7.7		1.6	6.1	Wait for transfer trucks, hood jams
13	8.1	.3	1.0	6.8	Miscellaneous iron, discharge jams
14	8.6		1.7	6.9	Excessive iron
15	8.1		.4	7.7	No problems
16	0		0	0	
17	0		0	0	Sunday
18	8.5		1.2	7.3	Wait for garbage, miscellaneous iron, discharge jam
19	7.8	1.0	1.3	5.5	Miscellaneous iron, broken conveyor weld
20	9.3		3.1	6.2	Bridging cardboard, wood, iron and couches
21	7.8		1.0	6.8	Wait for transfer trucks
22	8.7		2.6	6.1	Cardboard jam at pit, discharge jam, miscellaneous iron
23	0		0	0	
24	0		0	0	Sunday
25	8.5		1.0	7.5	Wait for transfer trucks, miscellaneous iron
26	9.0		.9	8.1	Wait for transfer trucks, miscellaneous iron
27	9.2		.9	8.3	Transfer conveyor electrical problem, loader hit emergency stop control
28	9.0		1.5	7.5	Miscellaneous iron, wait for transfer trucks, discharge jam

TABLE 33

DAILY PRODUCTION CHART

Date Mar.'74	Total Spin Time (Hrs.)	Break-Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	8.8	0	1.0	7.8	Miscellaneous iron
2	0		0	0	
3	0	0	0	0	Sunday
4					Plant down for major maintenance March 4 through March 18, 1974
5					
6					
7					
8					
9					
10					Sunday
11					
12					
13					
14					
15					
16					
17					Sunday
18	0	0	0	0	Snow, did not operate
19	8.8	0	1.3	7.5	Wait for garbage, cardboard bridge
20	8.1	0	.8	7.3	Hand loads slowed production
21	9.1	0	1.8	7.3	Transfer jam, iron. No. 2 packer down at 2:45 PM
22	9.4	0	1.3	8.1	No. 2 packer in production at 12:00 noon. Trucks held up (pressure switch on packer broken)
23	7.8	0	.8	7.0	Learbury cloth cuttings balled up. Removed from conveyor
24	0	0	0	0	Sunday
25	8.8	0	1.0	7.8	Wait for transfer trucks. No. 2 packer down, coupling
26	8.3	0	1.1	7.2	No. 2 packer in service at 12:30 PM. Wait for transfer trucks, transfer jam
27	7.9	0	.4	7.5	Good run
28	9.3	0	1.2	8.1	Wood bridge. Jam, iron
29	9.0	0	1.1	7.9	Bridge, iron
30	0	0	0	0	
31	0	0	0	0	Sunday

TABLE 34

DAILY PRODUCTION CHART

Date April '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	9.1	0	2.1	7.0	Flat tire loader, miscellaneous iron.
2	9.3	0	1.4	7.9	Miscellaneous iron, wait for transfer trucks.
3	9.0	0	2.0	7.0	Wait for transfer trucks, miscellaneous iron.
4	9.1	0	1.1	8.0	Wait for transfer trucks, bridge, hot water tanks.
5	7.8	0	1.2	6.6	Discharge jam, miscellaneous iron.
6					
7	0	0	0	0	Sunday
8	8.5	0	1.8	6.7	Pins-hood jam,discharge, jams.
9	7.8	0	1.4	6.4	Wait for transfer trucks,iron
10	10.0	0	2.2	7.8	Wait for transfer trucks, miscellaneous iron.
11	8.9	0	2.0	6.9	Wait for transfer trucks.
12	8.4	0	1.8	6.6	Wait for transfer trucks, miscellaneous iron.
13					
14	0	0	0	0	Sunday
15	9.9	0	2.3	7.6	Discharge jams, wait for transfer trucks.
16	9.6	0	1.7	7.9	Wait for transfer trucks, bridges.
17	9.2	0	1.6	7.6	Wait for transfer trucks,iron
18	8.0	0	1.1	6.9	Wait for transfer trucks, removing white goods, iron.
19	9.3	0	2.1	7.2	Wait for transfer trucks, bridge cardboard, iron.
20					
21	0	0	0	0	Sunday
22	8.3	0	1.3	7.0	Wait for transfer trucks, bridge/jams, iron.
23	8.7	0	2.1	6.6	Wait for transfer trucks, jams/bridge-white goods
24	7.9	0	1.2	6.7	Wait for transfer trucks, transfer jam - iron,
25	8.0	0	1.2	6.8	Wait for transfer trucks, paper slow down.
26	7.8	0	.8	7.0	Wait for transfer trucks.
27					
28	0	0	0	0	Sunday
29	8.5	0	2.3	6.2	Wait for transfer trucks, bridge, discharge jam.
30	8.3	0	1.4	6.9	Bridge-iron, wait for transfer trucks.

TABLE 35

DAILY PRODUCTION CHART

Date May '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	8.2	0	1.4	6.8	Miscellaneous iron
2	7.7	0	1.2	6.5	DPW trucks down on dump floor
3	9.2	0	1.5	7.7	Hood jams,wait for transfer trucks
4	0	0	0	0	
5	0	0	0	0	Sunday
6	9.2	4.0	1.1	4.1	Weld sweep housing, discharge jams
7	8.0	8.0	0	0	Weld lower section of shredder
8	8.4	0	.9	7.5	Discharge jams
9	7.3	0	1.8	5.5	Discharge jams
10	8.8	0	1.9	6.9	Discharge jams, fires
11	0	0	0	0	
12	0	0	0	0	Sunday
13	8.2	0	1.7	6.5	No. 1 packer down
14	8.5	0	2.3	6.2	Shear pins; iron, wait for transfer trucks
15	7.1	0	1.9	5.2	Tar paper bridge, wait for transfer trucks
16	9.8	3.7	1.0	5.1	Discharge fire
17	7.4	0	1.1	6.3	Wait for transfer trucks
18	0	0	0	0	
19	0	0	0	0	Sunday
20	9.2	0.7	2.6	5.9	Hood jam, transfer conveyor broken down
21	8.0	2.8	.4	4.8	Broken shaft on transfer conveyor,shut down early
22	8.2	0	2.1	6.1	Wait for transfer trucks, discharge jam
23	9.7	0	3.4	6.3	Flat tire, wait for transfer trucks
24	8.4	0	1.9	6.5	Broken pin, hood jam
25	0	0	0	0	
26	0	0	0	0	Sunday
27	0	0	0	0	Holiday
28	9.1	0	1.6	7.5	Hot water tanks, wait for transfer trucks, miscellaneous iron
29	8.1	0	1.8	6.3	Discharge jam, hood jam
30	9.1	0	1.3	7.8	Discharge jam,wait for transfer trucks
31	8.6	0	1.7	6.9	Wait for transfer trucks, flat tire, jams

TABLE 36

DAILY PRODUCTION CHART

Date June'74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	6.0	0	.6	5.4	Bridge, wait for transfer trucks
2	0	0	0	0	Sunday
3	8.7	0	2.0	6.7	Restrictor jams, wait for transfer trucks
4	7.7	0	.8	6.9	Iron, wait for transfer trucks, bridge
5	7.4	0	1.3	6.1	Wait for transfer trucks, restrictor jams
6	6.7	0	.5	6.2	Lost restrictor, iron, jam
7	7.2	0	.6	6.6	Iron, wait for transfer trucks
8	0	0	0	0	
9	0	0	0	0	Sunday
10	8.0	8.0	0	0	Shredder down, electric power switch
11	8.0	6.3	.1	1.6	Electrical
12	7.3	0	.9	6.4	Wait for transfer trucks
13	7.9	0	.3	7.6	Jams
14	7.7	0	.7	7.0	Iron, bridge
15	0	0	0	0	
16	0	0	0	0	Sunday
17	8.0	8.0	0	0	Electrical
18	7.6	0	.7	6.9	Jam, iron, bridge
19	6.6	0	.5	6.1	Iron
20	5.8	*1.1	1.2	3.5	[*Barrel wedge in discharge chute] - bridges, jams, iron
21	0	0	0	0	Shredder down-no water pressure
22	0	0	0	0	
23	0	0	0	0	Sunday
24	7.3	0	.7	6.6	Paper jams, hot water heaters
25	7.3	0	1.4	5.9	Wait for transfer trucks
26	7.5	0	.6	6.9	Wait for transfer trucks
27	6.7	0	.5	6.2	Bridge, restrictor jam
28	6.0	0	1.3	4.7	Broken sweeper blade, truck flat, wait for transfer trucks
29	0	0	0	0	
30	0	0	0	0	Sunday

TABLE 37

DAILY PRODUCTION CHART

Date July '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interrup-tion Time (Hrs.)	Pro-duction Time (Hrs.)	Remarks
1	8.4	*2.2	1.2	5.0	*No oil pressure,wait for transfer trucks
2	7.7	0	1.8	5.9	Discharge jams-iron,wait for transfer trucks
3	7.8	0	2.2	5.6	Miscellaneous iron-wait for transfer trucks
4	0	0	0	0	Holiday
5	9.4	0	3.1	6.3	Discharge jams,wait for transfer trucks
6	6.2	0	2.0	4.2	Jams,wait for transfer trucks, restrictor delays
7	0	0	0	0	Sunday
8	8.0	0	2.0	6.0	Wait for transfer trucks
9	8.2	0	2.8	5.4	Bridges-jams-wait for transfer trucks
10	7.7	0	2.7	5.0	Fire-jams-wait for transfer trucks
11	8.1	0	1.8	6.3	Wait for transfer trucks-bridge-hot water heaters and iron
12	7.8	0	1.6	6.2	Bridge-wait for transfer trucks
13	0	0	0	0	
14	0	0	0	0	Sunday
15	6.8	0	.6	6.2	Discharge jams-wait for garbage
16	8.1	* .9	1.6	5.6	*No oil pressure-discharge jam-wait for transfer trucks
17	7.7	0	1.1	6.6	Pins-miscellaneous iron-wait for transfer trucks
18	7.5	0	1.2	6.3	Material very dry-discharge jam
19	7.0	0	.7	6.3	Restrictor bridge and jam
20	0	0	0	0	
21	0	0	0	0	Sunday
22	6.5	*1.4	.4	4.7	*Belt pins loose,repaired
23	7.3	*1.9	1.0	4.4	*Repaired discharge baffle plate-no garbage-repaired screen
24	6.5	0	.3	6.2	Good day
25	7.6	0	.7	6.9	Discharge jam-miscellaneous iron
26	6.7	*1.5	.1	5.1	*Replaced 1 sweeper liner plate
27	0	0	0	0	
28	0	0	0	0	Sunday
29	6.7	0	.3	6.4	Good day
30	5.1	0	.5	4.6	No.2 packer replaced REX sprocket on pump
31	6.7	0	.4	6.3	Bridge

TABLE 38

DAILY PRODUCTION CHART

Date Aug. 74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	6.2	0	.8	5.4	Discharge jams-wait for garbage
2	7.5	0	1.7	5.8	Discharge jams
3	0	0	0	0	
4	0	0	0	0	Sunday
5	0	0	0	0	Shredder down,
6	0	0	0	0	changing
7	0	0	0	0	ring type grinders
8	8.9	0	2.0	6.9	Wait for garbage -restrictor problems caused broken pins
9	7.4	*1.0	.4	6.0	*Lost breaker bar
10	0	0	0	0	
11	0	0	0	0	Sunday
12	7.9	0	1.2	6.7	Wait for garbage - discharge jams
13	7.8	* .8	.9	6.1	*Lost breaker plate. Discharge jam-wait for garbage
14	6.3	0	.4	5.9	Hood jam
15	6.2	*2.0	.7	3.5	*Discharge conveyor broke
16	7.5	0	.4	7.1	Wait for garbage
17	0	0	0	0	
18	0	0	0	0	Sunday
19	7.9	0	1.4	6.5	Discharge jams
20	8.1	0	1,4	6.7	Hood jams - broke 3 pins - wait for garbage
21	7.4	0	.9	6.5	3 discharge jams - wait for garbage
22	8.6	*1.0	.9	6.7	*Explosion acetone - no major damage - discharge jams
23	7.7	0	1.2	6.5	Wait for garbage - restrictor and discharge jams
24	0	0	0	0	
25	0	0	0	0	Sunday
26	5.9	* .7	.2	5.0	*No oil pressure
27	7.6	0	.3	7.3	Good run
28	8.9	*3.6	.4	4.9	*Machine down, excessive oil pressure - clean jets - change oil
29	7.8	0	1.5	6.3	Wait for garbage - discharge jams - flat tire on payloader-wait for garbage
30	6.5	0	.4	6.1	Discharge jams
31	0	0	0	0	

TABLE 39

DAILY PRODUCTION CHART

Date Sept.74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	0	0	0	0	Sunday
2	0	0	0	0	Holiday
3	7.3	0	1.5	5.8	Wait for garbage-wait for transfer trucks
4	8.1	0	2.3	5.8	Discharge jams-wait for transfer trucks
5	7.9	0	.3	7.6	Bridge
6	8.0	0	.9	7.1	Discharge jams-wait for transfer trucks
7	7.2	0	.8	6.4	Wait for garbage
8	0	0	0	0	Sunday
9	7.6	0	1.0	6.6	Wait for garbage-wait for transfer trucks - bridging
10	8.0	0	1.2	6.8	Wait for garbage -bridge -discharge jams-hot water tanks
11	7.4	* .8	1.3	5.3	*Breaker plate broke off,hood jam - discharge jam
12	6.7	0	.4	6.3	Good day
13	6.9	0	1.1	5.8	Restrictor jam-miscellaneous iron
14	0	0	0	0	
15	0	0	0	0	Sunday
16	6.6	0	.8	5.8	Discharge jams,wait for transfer trucks
17	7.7	0	.6	7.1	Wait for transfer trucks
18	6.1	0	1.4	4.7	Wait for transfer trucks
19	7.0	*1.5	1.3	4.2	*Niagara Mohawk planned shutdown-No.2 packer down-wait for transfer trucks
20	7.2	0	1.3	5.9	No.2 packer -electrical problems -transfer conveyor broke
21	0	0	0	0	
22	0	0	0	0	Sunday
23	8.3	*5.5	.4	2.4	*Electrical short to discharge conveyor-machine down-No. 2 packer electrical relay
24	8.1	0	2.6	5.5	No.2 packer down-repaired-wait for transfer trucks
25	7.1	0	1.1	6.0	Bridging-miscellaneous iron wait for garbage
26	6.5	0	1.8	4.7	Wait for transfer trucks
27	6.2	* .7	.6	4.9	*Pipe caused discharge jam wait for garbage
28	0	0	0	0	
29	0	0	0	0	Sunday
30	6.5	0	.4	6.1	Good day

TABLE 40

DAILY PRODUCTION CHART

Date Oct. 74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	7.7	0	1.7	6.0	Discharge + hood jams - wait for garbage
2	6.5	0	.9	5.6	Wait for garbage
3	5.2	0	.5	4.7	Wait for transfer trucks
4	6.6	0	1.6	5.0	Wait for garbage-flat tire on loader
5	0	0	0	0	
6	0	0	0	0	Sunday
7	6.4	0	.6	5.8	Wait for transfer trucks and garbage
8	6.9	0	.6	6.3	Bridge-discharge jam
9	7.4	0	2.2	5.2	Miscellaneous iron-flat tire on loader - wait for garbage
10	6.5	0	.6	5.9	Discharge conveyor belt adjusted
11	7.2	0	.3	6.9	Discharge jams
12	0	0	0	0	
13	0	0	0	0	Sunday
14	6.5	0	.8	5.7	Discharge jams -wait for transfer trucks
15	6.5	0	1.2	5.3	Wait for garbage-Hot Water tanks-discharge & restrictor jams
16	5.7	0	.2	5.5	Miscellaneous iron
17	5.6	0	.1	5.5	Good day
18	8.0	*5.8	.2	2.0	*Machine down broke discharge conveyor drive shaft
19	0	0	0	0	
20	0	0	0	0	Sunday
21	6.6	0	.1	6.5	Good day
22	7.3	0	.4	6.9	Hot water tanks
23	5.8	0	.2	5.6	Good day
24	6.5	0	.5	6.0	Miscellaneous iron-hot water tanks-discharge jam
25	7.3	0	.9	6.4	Hot water tanks-Miscellaneous iron
26	0	0	0	0	
27	0	0	0	0	Sunday
28	8.0	*5.4	.0	2.6	Motors would not start-relays set too low
29	7.3	0	.8	6.5	Wait for garbage-wait for transfer trucks
30	6.1	0	.4	5.7	Wait for garbage-discharge jams
31	7.0	0	.4	6.6	Bridges

TABLE 41

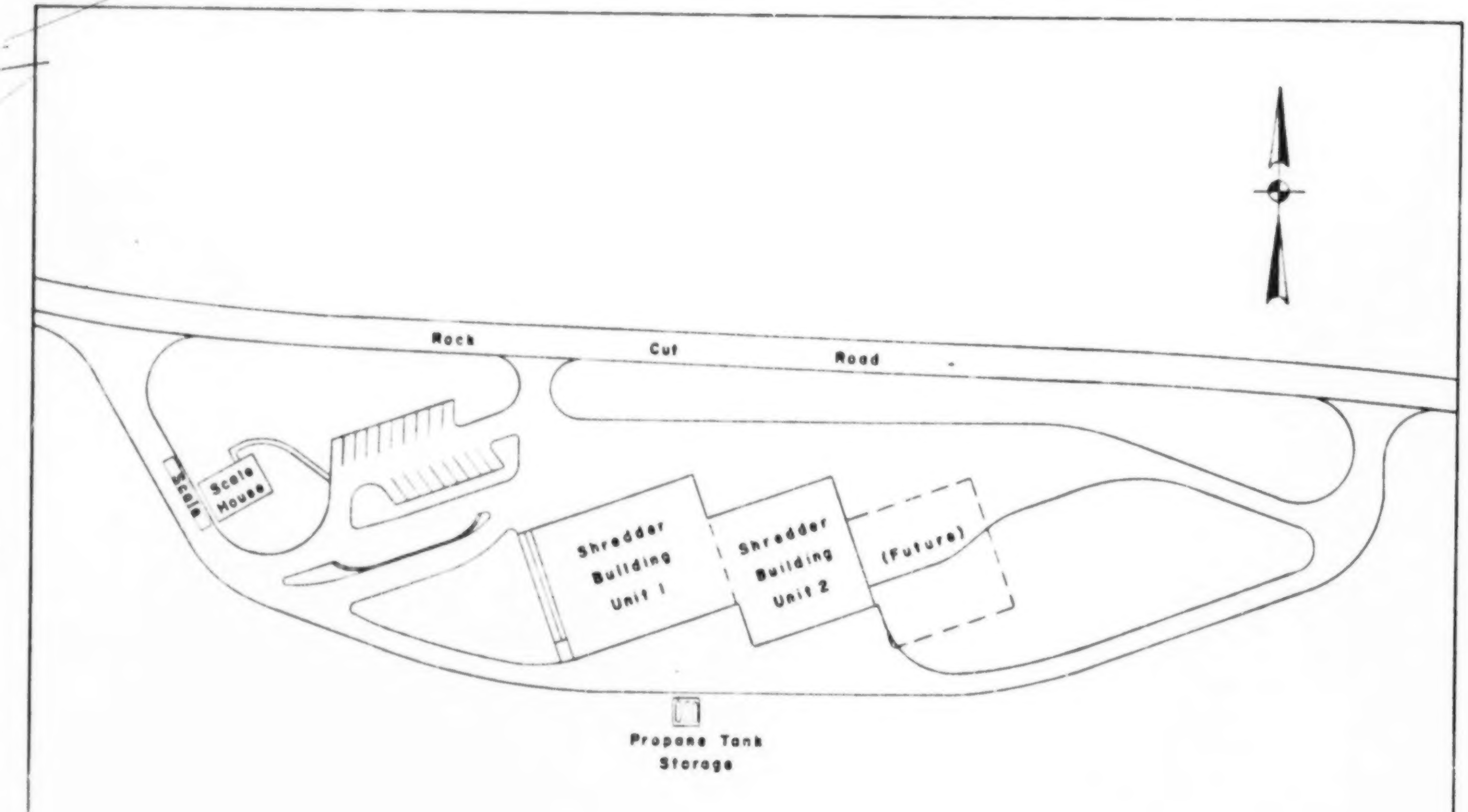
DAILY PRODUCTION CHART

Date Nov.'74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	6.0	2.0	.2	3.8	Machine down, Infeed conveyor jammed with hot water tank
2	0	0	0	0	
3	0	0	0	0	Sunday
4	6.4	0	.6	5.8	Wait for garbage & transfer trucks
5	7.2	0	.7	6.5	Wait for garbage & transfer trucks
6	6.0	0	.3	5.7	Wait for transfer trucks
7	6.2	0	.8	5.4	Wait for transfer trucks
8	6.4	0	.4	6.0	Bridge
9	0	0	0	0	
10	0	0	0	0	Sunday
11	6.0	0	.4	5.6	Discharge jam
12	6.4	0	.3	6.1	Good day
13	5.4	0	.1	5.3	Good day
14	6.1	0	.5	5.6	Hood jam
					*Had to cut out long sheet of tin
15	6.3	.6*	1.2	4.5	Hood & discharge jams
16	0	0	0	0	
17	0	0	0	0	Sunday
					*Had to clean out infeed conveyor
18	6.7	1.0*	.7	5.0	14 pieces iron rollers
19	6.7	0	1.0	5.7	Hood jam
20	6.8	0	1.0	5.8	Discharge jam - wait for transfer trucks
21	5.7	0	.8	4.9	Wait for transfer trucks - Rain, trucks slow
					*Sheet of steel caused discharge jam
22	6.6	.3*	1.2	5.1	Wait for garbage & transfer trucks
23	0	0	0	0	
24	0	0	0	0	Sunday
25	6.1	0	.5	5.6	2 discharge jams
26	6.6	0	1.5	5.1	Wait for garbage & transfer trucks
27	6.5	0	1.2	5.3	Wait for transfer trucks - discharge jams
28	0	0	0	0	Holiday
29	5.4	0	.5	4.9	Wait for transfer trucks
					*Lost breaker plate
30	5.3	.7*	.7	3.9	Wait for garbage & transfer trucks

TABLE 42

DAILY PRODUCTION CHART

Date Dec '74	Total Spin Time (Hrs.)	Break Down Time (Hrs.)	Matl's. Flow Interruption Time (Hrs.)	Production Time (Hrs.)	Remarks
1	0	0	0	0	
2	5.6	0	.4	5.2	Wait for garbage-transfer tr. No. 1 packer acting up
3	6.1	0	.9	5.2	Bridge-discharge jams-wait for transfer trucks
4	6.0	0	1.2	4.8	140-5 gal. pails in push pit-sticky liquid-hand pick (.6)
5	6.1	0	.5	5.6	Discharge jam
6	5.9	0	.9	5.0	Hardware-wait for transfer trucks
7	0	0	0	0	
8	0	0	0	0	Sunday
9	7.2	0	1.2	6.0	Discharge jam & bridge, No. 2 Packer down
10	6.8	0	1.3	5.5	Wait for trucks-Discharge jams *Transfer Conveyor down, weld drum.
11	7.0	1.6*	1.5	3.9	Wait for transfer trucks
12	6.4	0	1.1	5.3	Wait for transfer trucks-Pin broken in feed conveyor
13	6.2	0	.5	5.7	Good day
14	0	0	0	0	
15	0	0	0	0	Sunday
16	7.1	0	1.4	5.7	Wait for garbage and transfer trucks, bridge *Chain broke-transfer conveyor
17	7.1	1.0*	.9	5.2	Wait for garbage
18	6.9	0	1.8	5.1	Discharge jam-bridge-fire iron-wait for garbage
**19	3.5	0	.6	2.9	Discharge jams
20	6.0	0	.4	5.6	Discharge jams
21	0	0	0	0	
22	0	0	0	0	Sunday
**23	0	0	0	0	
**24	4.8	0	.5	4.3	Wait for transfer trucks
25	0	0	0	0	Holiday
** 26	4.2	0	.8	3.4	Wait for garbage & transfer trucks
**27	6.0	0	1.0	5.0	Wait for garbage & transfer trucks
28	6.0	0	.9	5.1	Wait for garbage
29	0	0	0	0	Sunday
**30	0	0	0	0	
**31	0	0	0	0	
					**Also ran shredder in Unit No. 2



SOLID WASTE MILLING FACILITY

SITE LAYOUT

FIGURE 28

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